COURSE OF STUDY

— IN —

INDUSTRIAL DRAWING

PREPARED FOR THE

Public Schools of Oakland, Cal.,

By PAUL A. GARIN,

PRINCIPAL OF DRAWING.

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COURSE OF STUDY IN INDUSTRIAL DRAWING.

GENERAL DIRECTIONS.

1.

Desire perfection, but do not expect it; at least not more than in writing of which industrial drawing is an extension. This course is intended neither for perfect teachers nor for artist-pupils.

2.

In this city, when a class is composed of two or more divisions of the same or of different grades, teach to all the course required from one of these divisions.

3.

All the pupils of the class should work simultaneously.

4.

Thirty seconds should be ample time for the distribution of drawing materials and getting ready for the lesson.

5.

Encourage the pupils to invent their own patterns. They are more interested in what they originate than in the best designs drawn for them.

6.

Definitions and etymology of geometrical terms not required, especially in the lower grades. A square is this: □. What is that? ▭ Ans. An oblong. If pupils can see the difference between the two figures and give the name of each, the teacher should be satisfied. Is it necessary to define tables, chairs, etc. to know what they are?

7.

Drawing time: At least one hour weekly. For young pupils, divide it into short and interesting lessons.

8.

No great difficulty is found in drawing, when the teacher:

(a) Studies, prepares, and practices each lesson before entering the school-room.

(b.) Uses few words and many corrections.

(c.) Never discourages his pupils, but, on the contrary, praises their efforts when he cannot commend their skill.

Let us remember that free hand drawing is only an approximate description of forms, and is not, like instrumental drawing, a mathematical representation of them.

FOR PUPILS.

9.

In free hand drawing, pupils are expressly forbidden:

(a) to measure;
(b) to rule;
(c) to erase lines.

10.

PENCILS should be:

(a) long; (b) well sharpened; (c) collected after each lesson; (d) kept for drawing purposes only.

11.

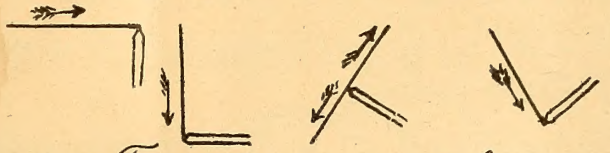
POSITIONS.

(a.) Keep the BODY erect.

(b.) The edge of the SLATE or DRAWING BOOK should be parallel with that of the desk.

(c) After each dot or line, the slate or book should be held vertically, at arm's length, in front of the eyes, turning the slate or book about for better examination.

(d) The PENCIL should be held 1½ inches from its point. It should be nearly at a right angle with the line to be drawn.



(e.) Turn the arm and body, not the book or slate.

12.

DOTS. (a) Light and small;

(b) When numbered, in this course, make them in the exact order of numerals.

(c) Never number dots on slates or in books.

(d) When dots are not numbered, in this course, they should be drawn, as much as possible, in the following order:

(1) center; (2) left; (3) right; (4) above, and (5) below the center.

Bisect and trisect lines and spaces from left to right, and from above to below.

13.

To draw a LINE:

(a) Make a dot for each end of the line; for a curve, other dots, showing its altitude.

(b) Without touching the slate or paper, carry the pencil three times over the path of the intended line.

(c) Sketch the line very lightly, looking at the dot it is desired to reach, and not at the point of the pencil. If the sketch be wrong, correct it, by drawing another light line.

(d) Line in with a slow, uniform motion, following the sketch.

(e) Make the line of the same size throughout its whole length.

(f.) Make it gray rather than white on slates or black on paper.

(g.) Move the pencil according to the directions indicated by the arrows in number 11.

NOTE on (a) and (b). In the 6th, 7th and 8th grades, leave out the dots when so directed. In the other grades, draw your lines at once, whenever you prefer it.

14.

In drawing parallel lines, keep all the time the first drawn line in sight.

15.

Except for given lengths, always draw on as large a scale as possible.

16.

Keep the drawing books clean and their pages properly numbered.

Draw one page each week.

17.

Practice often on the blackboard.

(a.) Draw the center of the figure on a level with and opposite to the eye.

(b) After each dot or line, stand a few feet from the board, in front of the sketch, and correct any mistake you can detect.

18.

Put the best original designs upon the blackboard.

Select the best to be copied by the class in their blank books.

As a reward, let pupils having found other good patterns copy them in their own books.

Books of Reference.

"Industrial Drawing for beginners: free hand." Jas. R. Osgood & Co. Boston. 1873.

"Inventional Geometry" by Wm. Geo. Spencer. Appleton's Science primers.

For Instrumental Drawing:

D. H. Mahan's "Industrial Drawing" N.Y. John Wiley & Co.

Bartholomew's Drawing Books Nos. 7 and 8. (old series.)

D 8TH

SLATE WORK.

§I.

Teach words: right, left, corner, dot.
Practice. To draw a dot in each corner of the slate.

§II.

Teach words: upper, lower.
Practice. To draw a dot:
(a) In the upper left corner of slate.
(b) " " upper right " " " .
(c) " " lower left " " " .
(d) " " lower right " " " .

§III.

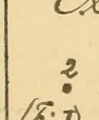
Teach: middle (of a line;) center (of an area); side.
Practice. To draw a dot:
(a) On the middle of the left side of slate.
(b) " " " " " upper " " " .
(c) " " " " " right " " " .
(d) " " " " " lower " " " .
(e) In the center of the slate.

§IV.

Teach: vertical, horizontal.
Exercise: To draw a vertical row of dots. To draw an horizontal row of dots. (No matter how far apart these dots may be provided they make straight rows.)

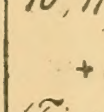
§V.

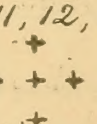
Teach: distance, margin.
Ex. The five dots.



(Fig. 1)

Dot 1 in the center of slate.
Dot 2 about ½ inch from left side of slate, in an horizontal line with the center.
Dot 3 on the right of center, at the same distance from center as dot 2 is from dot 1.
Dots 4 and 5 vertically above and below the center and at the same distance from it as dots 2 and 3.
Follow carefully directions 9, 10, 11, 12, and 15, on pp. 2 and 3.

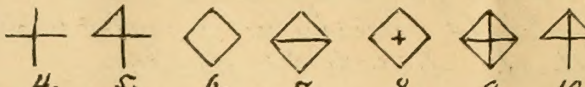

(Fig. 2)


(3)

Space as in fig. 1, above.

§VI.

Lines. See direction 13, page 3.
Repeat figure 1, §V.
Connect dots as in following figures. Drill the pupils to draw lines in all positions.



etc.

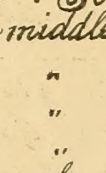
NOTE. It is not necessary to draw all these figures.

C 8TH

Review work of D 8TH

§VII.

Teach: between; oblique.
The Nine dots.

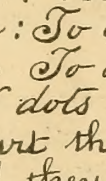


(Fig 11.)

See directions 9, 10, 11, 12, 13, 15, and 17.
Read note in §VI above.

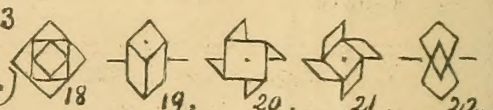
§VIII.

The 13 dots.



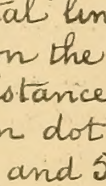
(Fig. 17.)

Read note §VI above, and directions 9, 10, 11, 12, 13, 15 and 17.

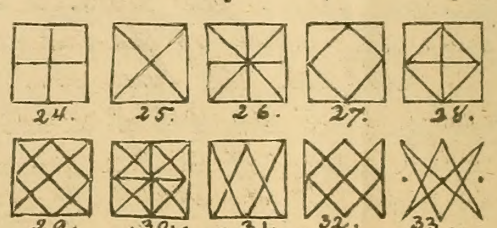


§IX.

Teach: square. Make paper squares; pass them to the class.
The nine dots of a square.



(Fig. 23.)



How many capital letters can you make with these nine dots? Each line must begin upon one and end upon another of these nine dots.

Ans.— 11 letters. I, L, E, F, H, T, Z, N, V, M, K;

Fig. 34.

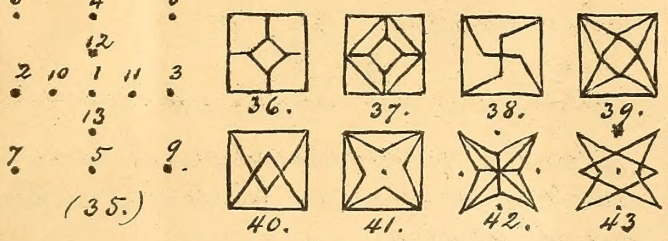
B 8TH

Review work of C 8th and D 8th

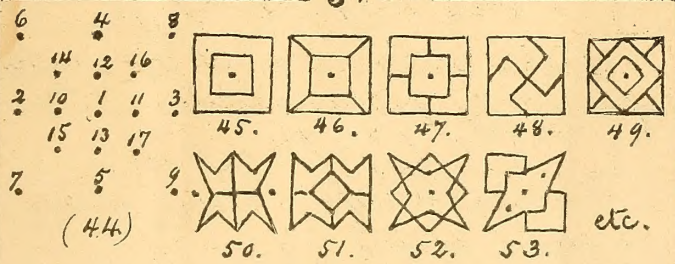
§X.

See note in §VI, and directions 9, 10, 11, 12, 13, 15, and 17, pp. 2 and 3.

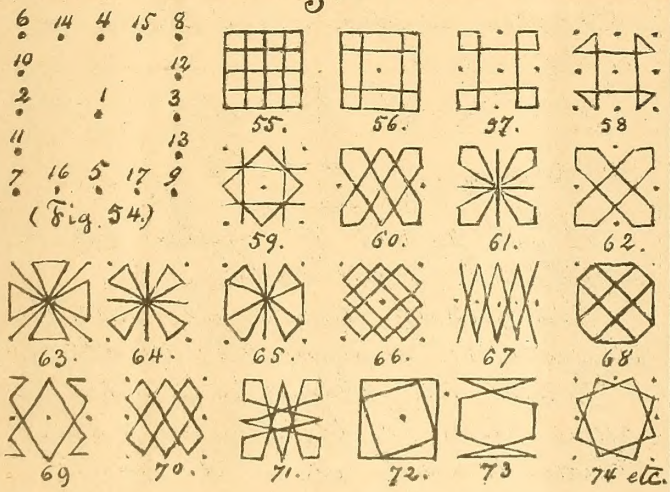
Teach: diagonals of a square.



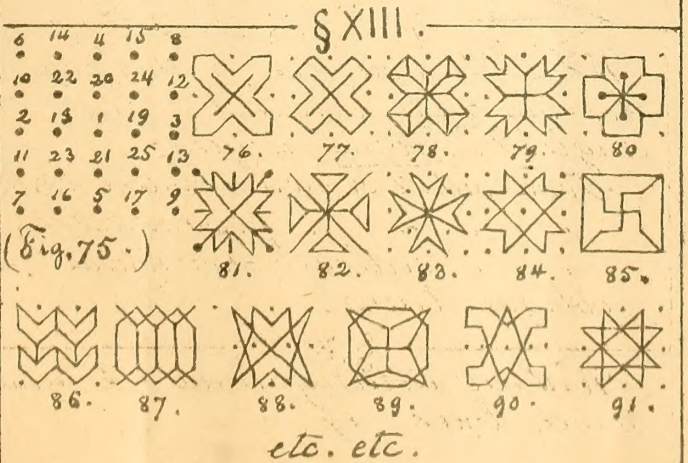
§XI.



§XII.



§XIII.



etc. etc.

A 8TH

Review work of B 8th. C 8th & D 8th

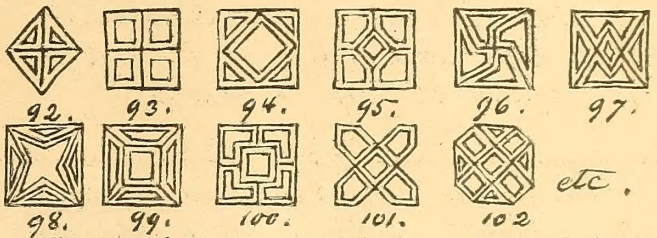
§XIV

See note in §VI, and directions 9, 10, 11, 12, 13, 14, and 17, pp. 2 and 3.

Teach: parallel.

Select any of the preceding figures having few lines. Draw lines parallel to those of the figures selected.

Examples from fig. 8, 24, 27, 36, 38, 40, 41, 46, 47, 62, 68,



Any other pattern or patterns based upon diagrams used heretofore may also be introduced.

§XV.

Practice on parallel lines for half-tints. (See dir. pp. 2 and 3.)

Finish outer parallel lines of fig. 109 & 110.

§XVI.

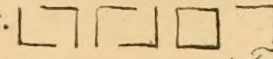
INCH. Teach: inch.

Pupils may look at inch lines or spaces but should <u>not measure</u> their own work. The teacher or monitors should do so.

In crediting an examination make the following allowances:

A line $\frac{1}{16}$ less to $\frac{1}{16}$ more than <u>its given length</u>, to be marked perfect. So that a line $\frac{15}{16}$ to $1\frac{1}{16}$ inches is received as a one inch line; another $1\frac{7}{8}$ to $2\frac{1}{8}$ in. is called a two inch line; etc.

Draw inch lines without dotting.

Ex.  etc.

(Fig. 111)

Draw vertical, horizontal, and oblique rows of dots, one inch from dot to dot.

B. 7TH.

Review work of 8th grade.

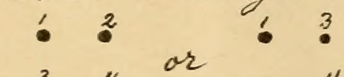
New Matter.

Two and three inch lines and spaces. — Trisecting. — Oblongs. — Geometrical terms. — Diagrams of dots for inventive drawing.

See directions 5, 6, 9, 10, 11, 12, 13, 14, 15, 17, and 18, pp. 2 and 3.

§XVII.

Can you construct a square by first dotting its 4 corners?

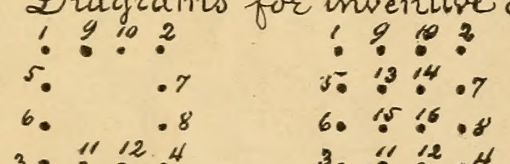


(112)

Give this figure as much margin below as above, on the right as on the left.

Teach: bisect, trisect.

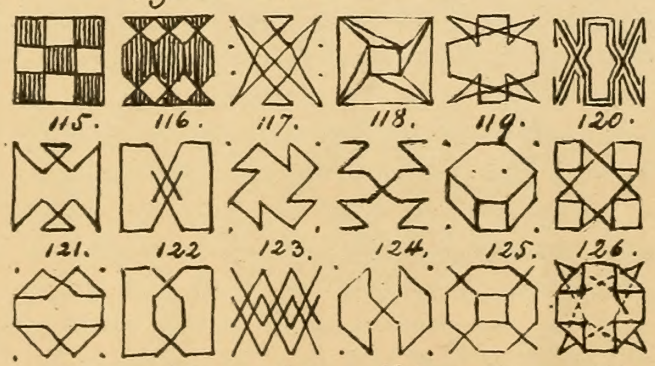
Diagrams for inventive drawing.



(Fig. 113.) (114.)

NOTE. Every line should begin upon one dot and end upon another dot of the diagram.

Ex. for teachers.



115. 116. 117. 118. 119. 120.

121. 122. 123. 124. 125. 126.

127. 128. 129. 130. 131. 132.

etc., etc.

§XVIII.

Teach: ~~vertex~~ ~~side~~ angle.

Can you make one angle with two straight lines?

Can you make 2 angles; 3 angles; — 4 angles; — 5 angles, with the same (2) lines? ans.

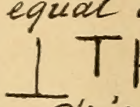
One angle:  .

Two angles:  .

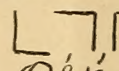
Four " +, X

Three and five angles are impossible.

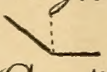
Teach: perpendicular. A line meeting another so as to make two equal angles.

 etc.

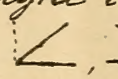
Right angle: One of the angles formed by perpendicular lines.

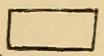
 etc

Obtuse angle. More than a right angle

 etc.

Acute angle. Less than a right angle

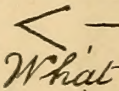
 etc

Oblong:  etc.

What kinds of angles in a square? — an oblong?

How many diagonals can be drawn in a square? — an oblong?

Draw the following angles on your slate (or blackboard) and close to each write its name.



What do you see, in this room, having right angles? — acute angles? — obtuse angles?

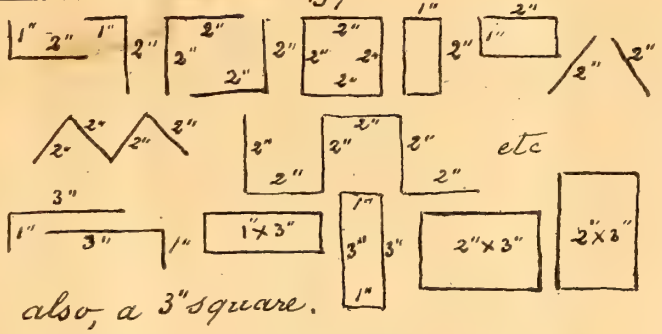
Point out 2 or more parallel lines.

" " 2 " perpendicular " .

" " vertical; — horizontal; — oblique lines.

§XIX.

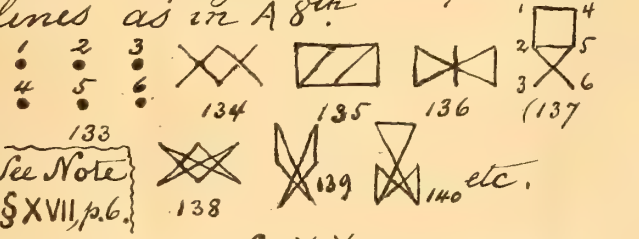
Without dotting, draw 1, 2, and 3 inch lines: ex.



also, a 3" square.

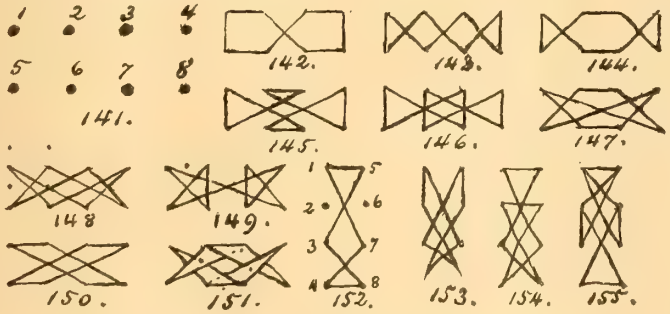
DIAGRAM FOR DESIGNING.

Note. Dots for this and following diagrams should be drawn one inch apart. Repeat with two inch and three inch lines and spaces. When the slate is too small, use the blackboard. See §XVI, page 5. Draw parallel lines as in A 8th

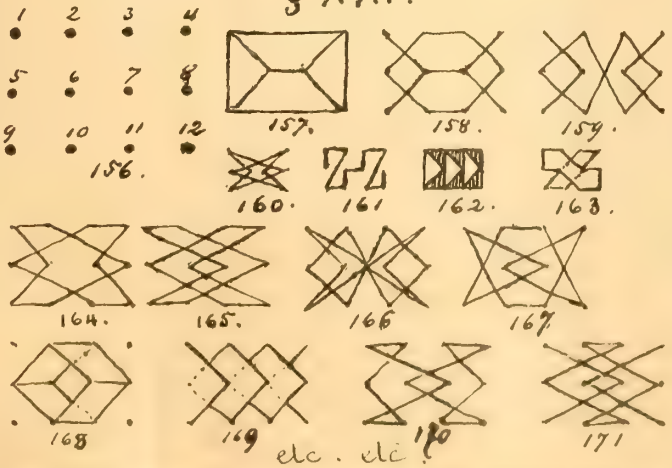


§XX.

(§XIX continued.) Use parallel lines in easy figures. Do not forget direction 5, page 2;
Put best original designs upon the blackboard.



§XXI.



A7TH.

Review work of B7th and 8th gr.

New Matter.

Four inch lines and spaces.

Changing straight lines into simple curves.

Reversed curves.

§XXII.

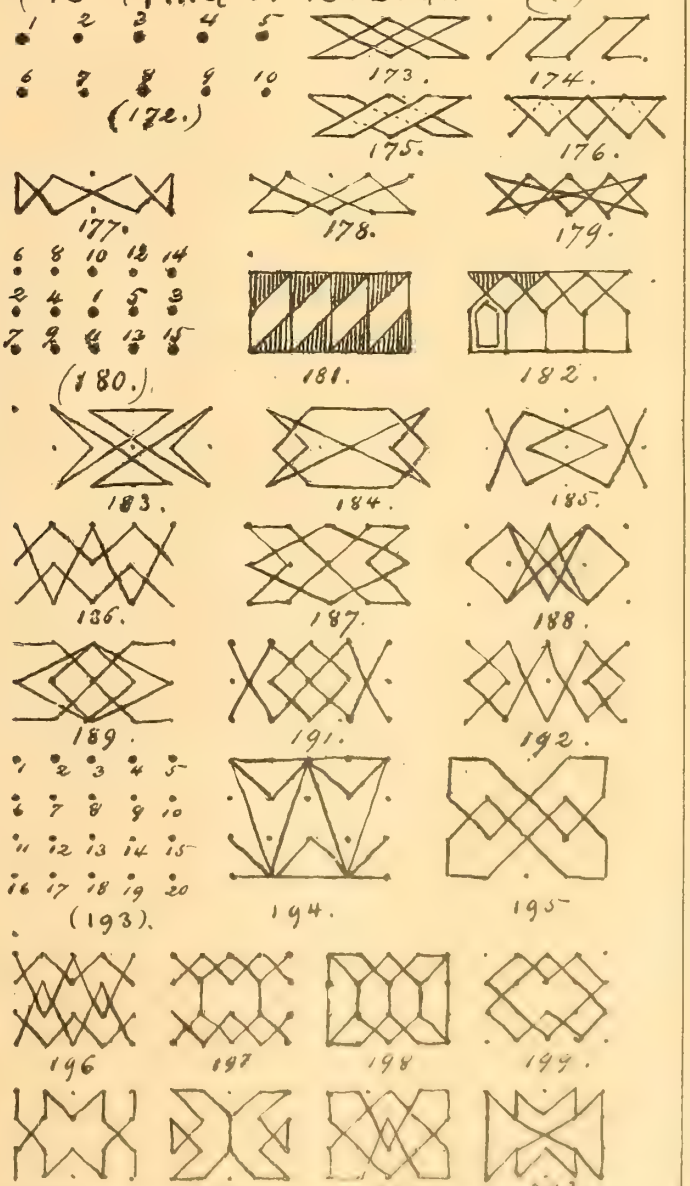
See directions 5, 6, 9, 10, 11, 12, 13, 14, 15, 17, and 18.

Original designs from diagrams as in B7th

(Without dotting.) 1"×4"

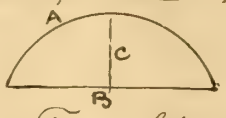
Other oblongs 2"×4" 3"×4" + a 4" square.

(DOTTING & DESIGNING.)



§ XXIII

Teach: Simple curve, base, altitude.

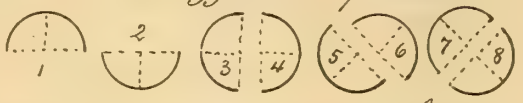


A Simple Curve.
B Its base.
C Its altitude. The altitude is always perpendicular to the base.

Describe the following curves:

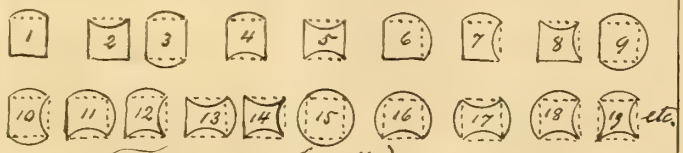
Base =	4"	4"	4"	3"	3"	etc.
Altitude =	2"	1"	½"	1"	½"	

Can you draw any of the above curves in 8 different positions?

Ans. 

Can you draw a curve whose altitude will be ½ its base? – ¼ its base? – ⅓ its base?

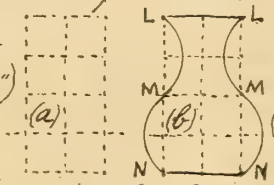
Can you make 10 different figures by changing the sides of a square into simple curves? — Ans.



This ⌒ (204) is a reversed curve; it is made of two simple curves.

Can you draw a reversed curve in 4 different positions?

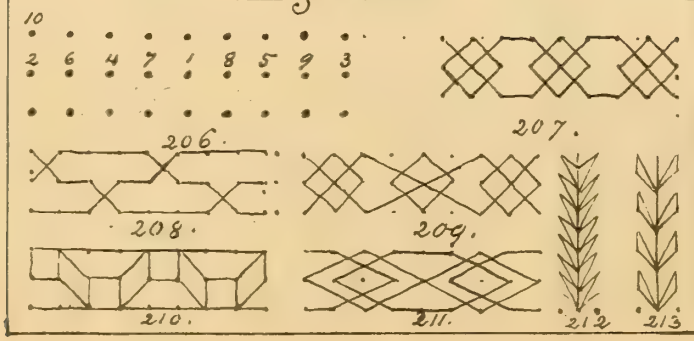
Can you draw an oblong (2"x4") and divide it as in (a); then make a vase as in (b)?



(205)

Do not stop at M but describe the curve with one stroke from L to N.

§ XXIV.




214.


215.

B 6TH

BLANK BOOKS.

Summary. Geometrical Terms. — Simple curve. — Circle. — Dividing it into 3, 4, 6, and 8 equal parts. — Inscribing triangles, squares, regular hexagons and octagons. —

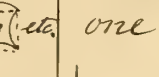
Follow closely general directions on pp. 2 and 3.

Geometrical Terms.

Note. Teach only a few terms in each lesson.

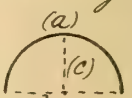
A line is vertical, horizontal, or oblique.

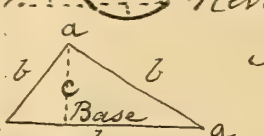
Two lines are parallel, perpendicular, or oblique.

An angle has two sides and one vertex .... 

└ right, \ obtuse, ∠ acute angles.

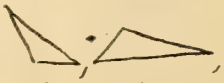
Simple Curve (a); base (b) altitude (c)



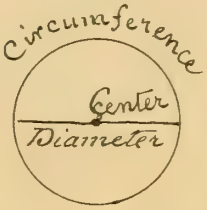

Reversed Curve.

Triangle: a, a, a, angles; b, b, b, sides; c, altitude.


, Right-angled Triangles.


, Obtuse " "

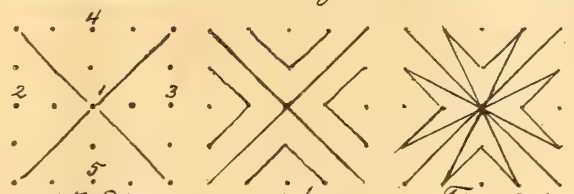

Acute " "

Circle: 

Following is the work for each page of the blank books.

NATIONAL BLANK DRAWING BOOKS - 6½ × 7½ IN.

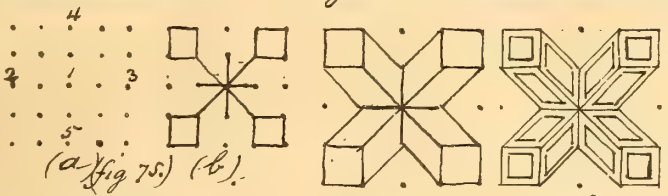
Page 1.



1st Stage 2d. Fig. 216.

After being drawn upon the blackboard, fig. 216 is sketched in the blank books. Let dots 2, 3, 4, and 5 be two in. from center.

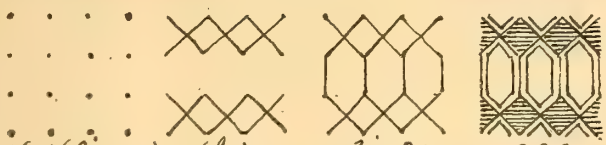
Page 2.



(a) (fig 75.) (b). 217. 218.

Dots 2, 3, 4, and 5 two in. from center. Draw either fig. 217 or fig. 218.

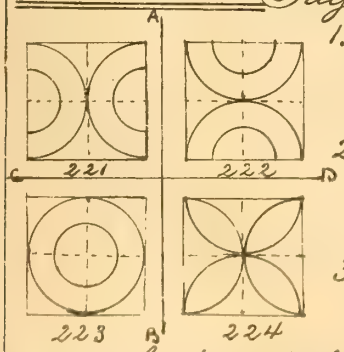
Page 3.



(a) (fig. 114.) (b) fig 219. 220

Draw, in the center of the page either fig. 219 or 220. Size 4" × 4".

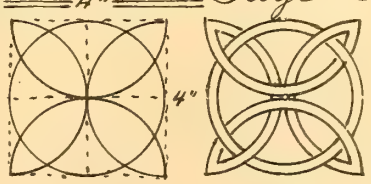
Page 4.



1. Draw lines A B & C D through the center of page 4.
2. Squares 221, 222, 223, and 224 = 2" × 2" each.
3. Divide each square into 4 equal squares.
4. Go several times over the path of the intended line without touching the paper with the pencil.
5. Describe the curve lightly, with one slow and steady stroke, stopping only when the end of the curve is reached.
6. Correct and line in.

Fig. 224. Describe ½ circles, from corner to corner through center.

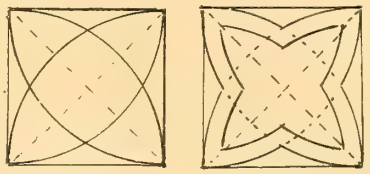
Page 5.



225. 226.

This is nearly fig. 224 enlarged. Square 4" × 4". Draw either fig 225 or 226.

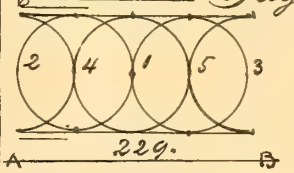
Page 6.



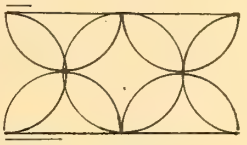
227. 228.

Draw either fig. 227 or 228. Square 4" × 4". Curves are ¼ of circumference.

Page 7.



229.

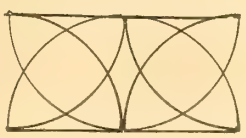


230.

1. Draw line A B through center of p. 7.
2. Each oblong is 2" × 4.
3. Use diagram fig. 180, p. 7.
4. If desired, parallel lines may be drawn.

Page 8.

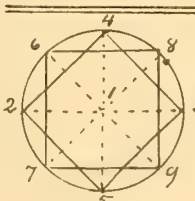
231.



232.

Work this page like the last. Oblongs = 2" × 4" each.

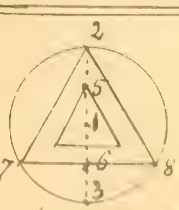
Page 9.



233.)

1. Draw dots 1, 2, 3 and describe a circle (4" diameter.)
2. Add dots 4, 5, 6, 7, 8 and 9.
3. Draw dotted lines 4-5, 2-3, 8-7, 6-9.
4. Inscribe two squares.

Page 10.



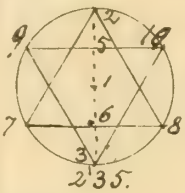
234.)

Draw dots 1, 2, 3, and describe a circle (4" diam.) Divide 2-3 into 4ths. Through 6 draw [illegible]. From 5 draw lines parallel to sides of △

BLANK BOOKS

Page 11.

(a) Describe circle (4 in. diam.).
(b) Divide 2-3 into 4ths.
(c) Through 5 & 6 draw lines 9-10 and 7-8.



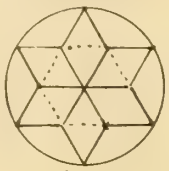
235.


236.

(d) Construct two equilateral triangles.
Draw either fig. 235 or 236.

Page 12.

4" diam.

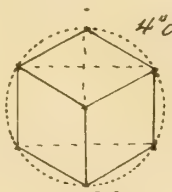

237.

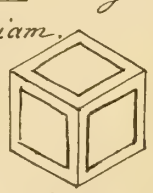

238.

Draw fig. 235 lightly.
Add the other lines.
Copy 237 or 238.

Page 13.

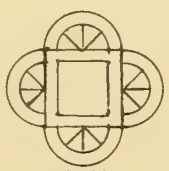
4" diam.


239.


240.

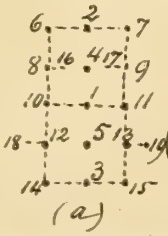
Divide circumfer. of circle into 6ths as in fig. 235
Copy 239 or 240.

Page 14.


241.

Dotting: fig. 17 p. 4.
Dots one inch apart.
Draw square, then semi circles.
Parallel lines 1/3 in. from others.

Page 15.

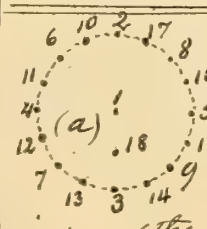


(a)


242

Oblong 2" × 4".
Dots one inch apart.
Altitudes = 1/2 in.
Add lines above and below the oblong.

Page 16.



into 16ths


(243)

Draw 1-2-3 and circle (4" diam.)
Add 4, 5, 6, etc. dividing the circumference
Copy fig. 243.

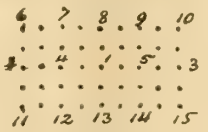
A6TH

New Matter. Changing straight lines into curves.
Review: Geometrical Terms of B6TH

Observe: "General Directions" pp. 2 and 3.

BLANK BOOKS.

Page 1.



(a)


(b)

2" × 4"


fig. 244

A B

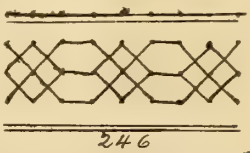
Same diagram (a)

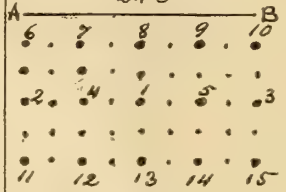

b.


245.

1 Draw AB through center of page
2 Draw diagram fig. 247 in the center of each half page.
3 Each oblong = 2" × 4". Draw only fig. 244 and 245.

Page 2.


246

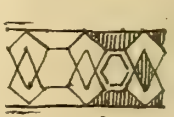


(247)

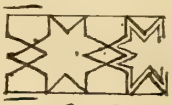
Follow dir. 1, 2, 3 of last lesson.
Draw 246 in the center of the upper half of this page.
Make a design (in the lower half), using diagram 247.
Should the class fail to find a good pattern, one of the following fig. may be drawn and improved.

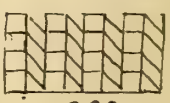

248.


249.


250.


251.


252.


253.

Page 3.

4" sq.


254

Diagram fig. 75, page 5.
Square = 4" × 4"
Inner circles 1/2 diam. of outer circles.

Page 4.

To change straight lines into curves.
Divide page and draw diagrams of 45 dots as for fig. 244 and 245, or fig. 246 and 247 above.


255.

Describe curves with low altitudes.
Pupils to find their own patterns.
(For teachers.)


256

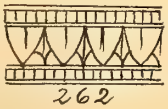

257.


258.

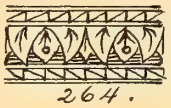

259


260.


261.


262


263


264.

GEOMETRICAL TERMS.

Triangles named from the relative length of their sides:

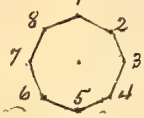

Equilateral (equal + sides).


Isosceles (equal legs.)


Scalene (limping.)


Concentric circles (With the same center.)

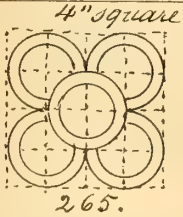
Regular Hexagon. (Six corners)



Regular Octagon. 8

Regular when it contains equal angles and equal sides.

Page 5.


4" square.

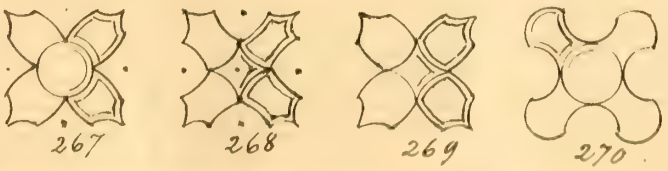
Dotting either fig. 54 or 75. page 5.
Inner circles ¼ inch distant from the others.

265.

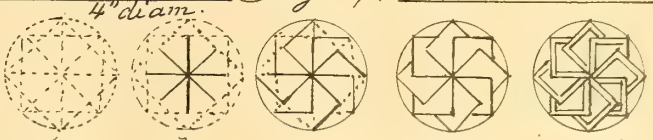
Page 6

To change into curves:
Size = 4" × 4"
Diagram fig 54.
Short altitudes.
(For the teacher.)


266


267 268 269 270

Page 7.

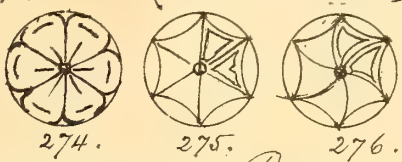

4" diam.
(a) (b.) (c.) 271 272

(a) is fig. 233. Copy either 271 or 272.

Page 8.

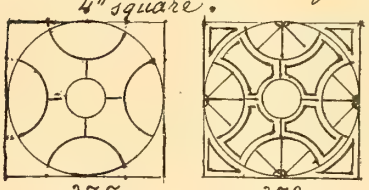
To change into curves.
Circle = 4" diameter.
Divide it into 6ths. (Fig. 235, etc.)
(For the teacher.)

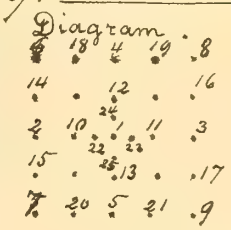

273.


274. 275. 276.

etc.

Page 9.


4" square.
277 278



279

Draw either fig.

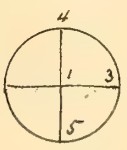
Page 10


4" diam.
280.

To change into curves.
(For the teacher)

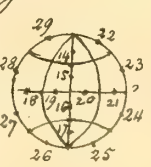

281. 282. 283.

Page 11.

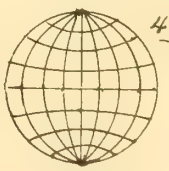


(a)

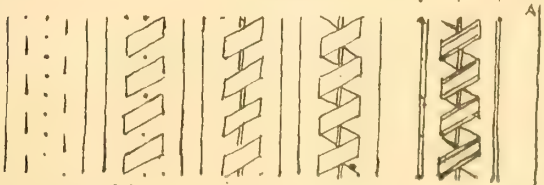
(b)

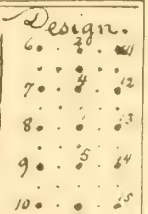


(c)


4" diam.
284.

Page 12.

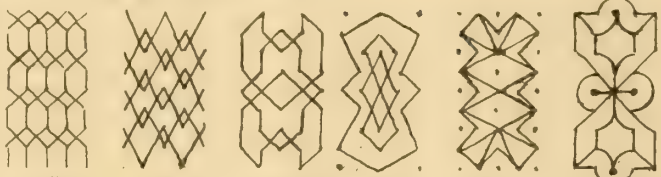

(a) (b) (c) (d) 285



286.

Draw A B through center of page.
Dot diagram 286 on both sides.
Copy 285 on the left side and a design made of straight or of curved lines on the right side of A B.
Do not select hard and complicated patterns. (Over.)

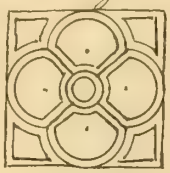
For the teacher:



287. 288. 289. 290. 291. 292.

Page 13

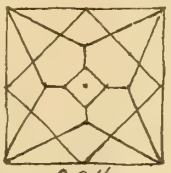
Sketch diagram 279 p. 11.

Fig. 293. 

Size: 4"x 4".

Page 14.

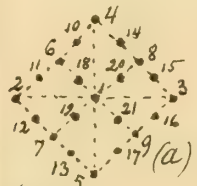
To change into curves.
Diagram fig. 279. (Size 4"x4")
For teachers.



294

295. 296. 297. 298. 299.

Page 15.



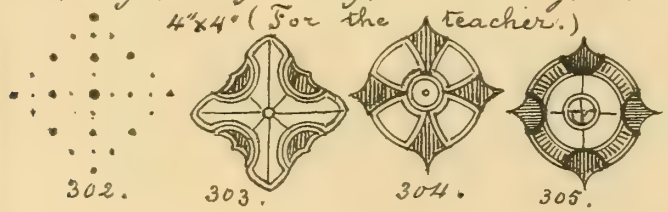
(300)

301.

Copy fig. 301.
23 = 4"
45 = 4"

Page 16.

Diagram of dots for a design.
4"x4" (For the teacher.)



302. 303. 304. 305.

B5TH BLANK BOOKS.

NEW MATTER.

1° Angles of 45 and 90 degrees.
2° Dividing areas symmetrically.
3° Modifying middle of lines.
4° Dividing lines and spaces into 5ths.

GEOMETRICAL TERMS.

Quadrilaterals or Quadrangles
= 4 sides = 4 ∠s

I. Parallel sides:

(a) Rectangles: ∘ right ∠s

Square. Oblong.

(b.) (No right ∠s) Rhombus. Rhomboid.

II. Sides not parallel:

Trapezoid.

Trapeziums. (Two sides are parallel; the other two are not)

-oid = resembling.

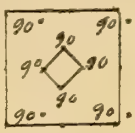
Teach also: radius, arc, sector, quadrant, octant, degree. (See below.)

Review Geom. Terms of A and B6, pages 8 and 11.

Page 1

of National Blank Drawing Books.

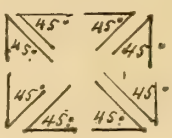
306.



307.

- Divide page into 4ths
- Circles = 2" diamet.
- 2" squares.

308.



309.

Before working in the blank books, the pupils draw the following on their

SLATES.

Describe 4 circles. In the first draw one radius ; two radii . What is a radius? What are radii? What is an arc? What is the name of a figure bounded by an arc and two radii?

Write the names arc, radius, sector close to the line or figure each represents.

Divide the 2d circle into four equal sectors.

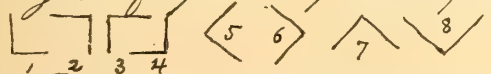
Write the individual name of each of these sectors. (Quadrant.)

Divide the third (3d) circle into 8 equal sectors.

Write the individual name of each of the sectors. (Octant.)

Could the 4th circle be divided into 360 sectors? What do they call one of these

sectors? (a degree, abbr. °)
The arc of such a sector is an arc of one degree.
" angle " " " " " " angle " " "
How many degrees in the circumference of a circle? (360°)
How many degrees in $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ of it?
" " " " in the arc of a quadrant?
" " " " " " " an octant?
What kind of an angle is that of a quadrant? (a right angle.)
---- of an octant? (an acute angle.)
What is the name of an angle having 90°? less than 90°? — more than 90°? (an obtuse angle.)
Draw a vertical line; draw another making an angle of 90° with it. Draw the same angle of 90° in 7 other positions.



Draw 8 angles of 45°, each in a different position.

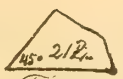
Books.

Draw fig. 306, 307, 308, and 309. in your blank books and write neatly the number of degrees of each angle. (Ex. 90°; 45°.)

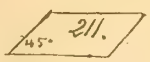
Page 2.

Diag. = $1\frac{1}{2}$ & 2".

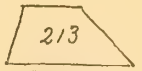
Rhombus.



Trapezium.



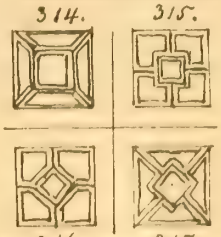
Rhomboid.



Trapezoid.

Give this lesson like the last. Begin by a slate exercise on quadrilaterals (p. 12.) then draw figures 210, 211, 212, and 213 in the books, writing, also, neatly the name of each quadrangle.

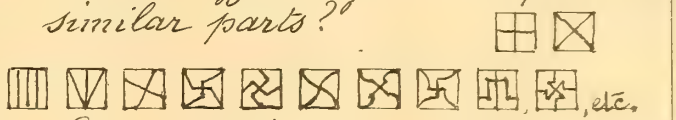
Page 3.



Slates.

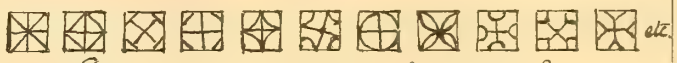
Can you divide a square into four equal and similar parts?

How many squares could you divide differently into 4 equal and similar parts?



Can you divide 3, 4, 5, etc. squares into five (5) symmetrical parts; each square being divided differently?

... Into 8 symmetrical parts?

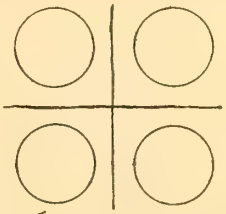


... Into 9 symmetrical parts?

Books.

Draw four of your designs. Add parallel lines.
Squares = 2" × 2".
Fig. 314, 315, 316, 317 are samples you may copy if you like.

Page 4.



This is similar to the last lesson.
Most of the divisions of the square may be applied to the circle.
Diam = 2".

In how many different ways can you divide a circle into
4 symmetrical parts?

----- 5 symmetrical parts?

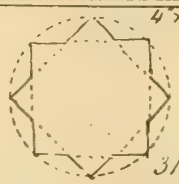
----- 6 symmetrical parts?

----- 8 symmetrical parts?

..... 9 symmetrical parts?

Page 5.

4"x4".



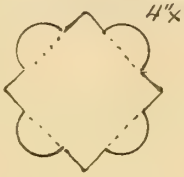
319.

Draw fig 319. Divide it symmetrically. Add parallel lines. Select best design? (For teachers.)

320 321 322 323 324

Page 6.

4"x4".

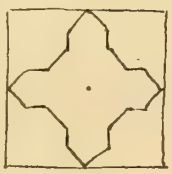


325

To divide symmetrically fig. 325. Work as above. Use more curves.

Page 7.

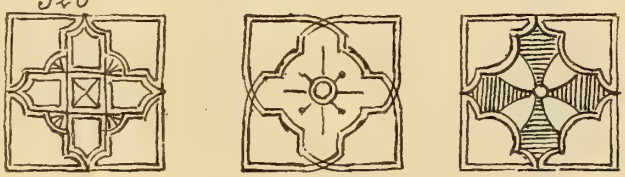
Improve fig. 326.



326

327

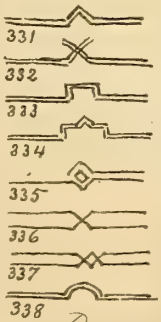
Draw curves, if possible. Size 5"x5".



328. 329. 330

Page 8.

Modifying middle of lines.



331 332 333 334 335 336 337 338

Find 8 others, for the right side of this page. Use curves also.

Pupils should not be helped too much. Start them a little then let them find out their own designs. See directions 5, 8, and 18, pp. 283.

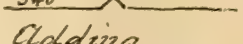
Parallel lines and interlacing recommended.

Preliminary Work

Draw series A upon the blackboard.

Series A. Unit of design: 339.

Extending lines. 340

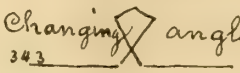


Adding. 341

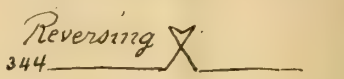
Adding. 342

Changing angles. 342

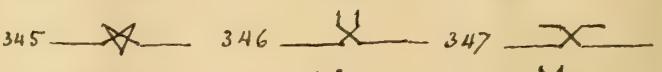
Changing angles 343



Reversing 344

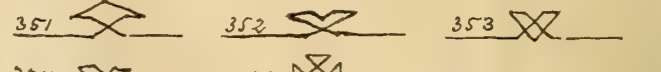


345 346 347



348 349 350

351 352 353

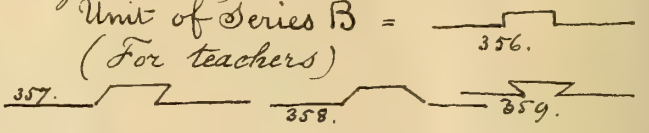


354 355 etc., etc.

Give the pupils unit of series B and tell them to find other designs, using the same means as in series A (, adding, changing size of lines, angles, etc.).

Unit of Series B = 356.

(For teachers)



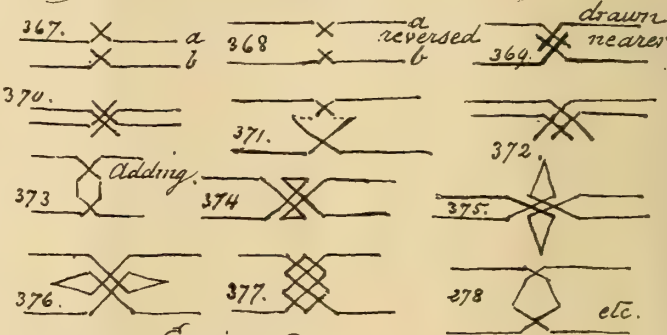
357. 358. 359.

360. 361. 362.

363 364 365.

366 etc., etc.

Series C. (With two units)



367. a b 368 a reversed b 369. drawn nearer.

370. 371. 372.

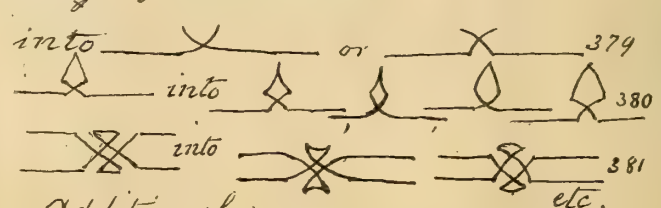
373 Adding. 374 375.

376. 377. 378 etc.

Series C.

To change into curves the lines of above or similar patterns.

Change for instance



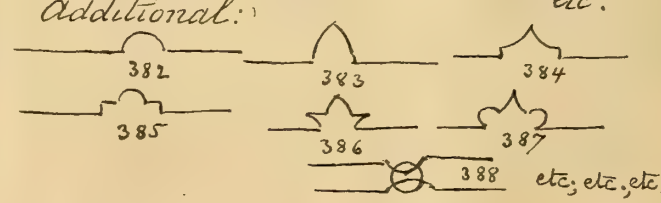
into or 379

into 380

into 381

etc.

Additional:

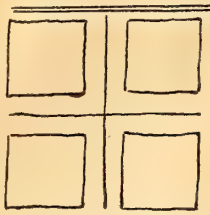


382 383 384

385 386 387

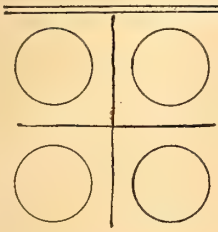
388 etc, etc, etc.

Page 9.



Construct four 2" squares.
Change the middle of each side of each square.
Practice first on slates or blackboard.
Select best designs.

Page 10.



Describe 4 circles; each 2" diam. or 1" radius.
In 4 different ways modify (at 3, 4, 6, or 8 points) the circumferences of these circles.
Improve them by dividing their areas, drawing parallel lines, etc.

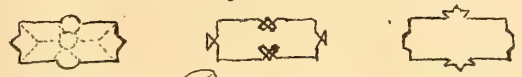
Page 11.

2"×5"

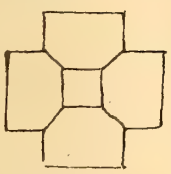
2"×5"

This page is to be done like last two pages.
Upper and lower sides may be different from right and left sides.

Ex. 389.



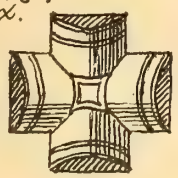
Page 12.



390

5"×5".
Improve by modifying lines, dividing, curves, etc.

Ex. 390

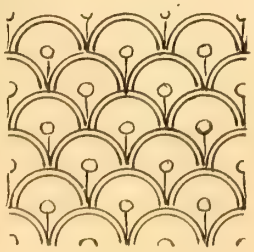


391

392

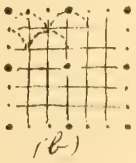
393

Page 13.



394.

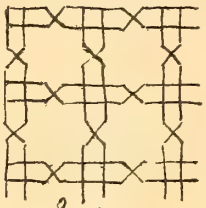
Size = 5"×5"
Trisect.



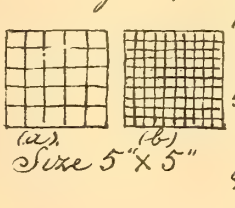
(a) (b)

Make all the semi-circles exactly alike.

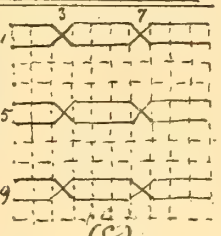
Page 14.



395.



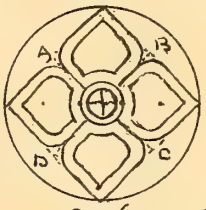
(a) (b)
Size 5"×5"



(c)

Proceed as shown in (a), (b), and (c)
In (c), count the squares on the sides.

Page 15.

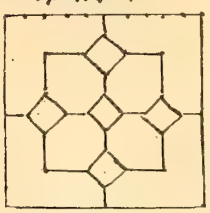


396.

2" radius or 4" diameter.
Divide diameter into 5ths to find size of small circle.
At points A, B, C, D be careful not to make angles in joining lines and curves, thus: A (wrong)
Round the curves more; ex. A

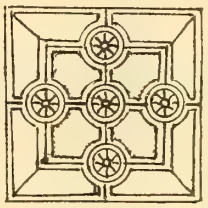
Page 16.

4"×4".

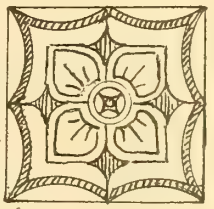


397

Improve. Divide into 5ths and 10ths
(For teachers.)



398



399.

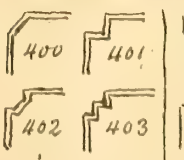
A 5TH

New Matter:

1° Modifying corners.
2° Compound reversed curves.
3° Angles of 30° and 60°.
4 Oblique projections of the cube and its sections.

Directions pp. 2 and 3.
NATIONAL BLANK DRAWING BOOKS.

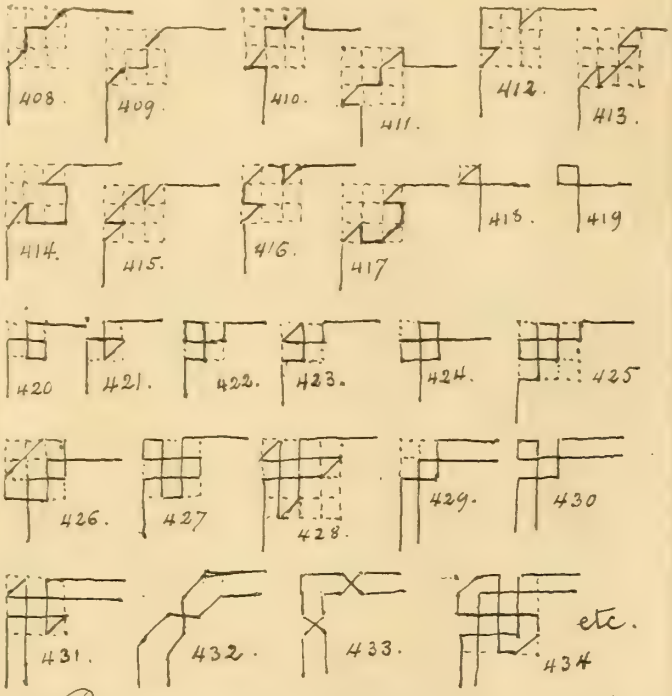
Page 1



Use straight lines only.
Draw parallel lines.
Put 4 corners in each ¼ of page.

Find 8 other corners for lower ½ of this page.

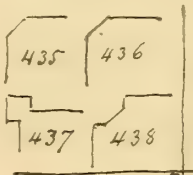
The long lines of corners to be about one inch.
(For teachers.)

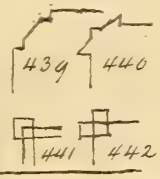


Pupils may copy corners from illustrated papers, books, etc.

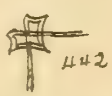
Page 2.

Change into curves.



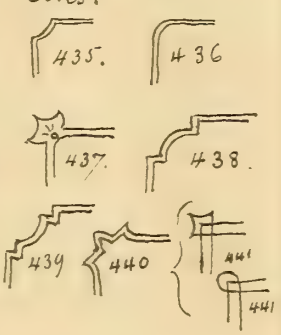


Find 8 other corners for this lower ½ page. They should be made of curves. Use parallel lines.

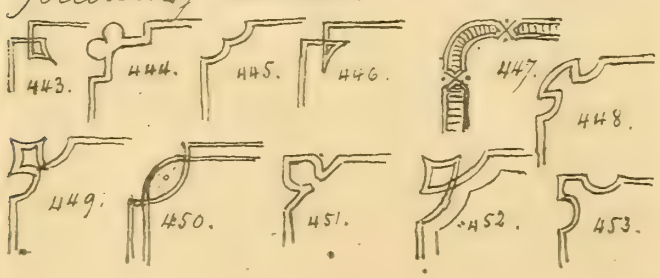


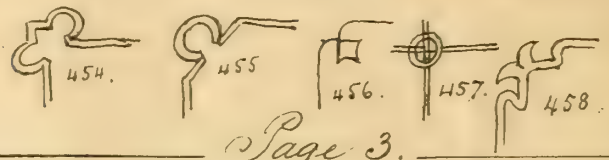
Put 4 corners in each quarter of this page.

Ans.

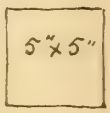


Should the pupils fail to originate good designs for the lower half of the page, they may copy 8 of the following corners.



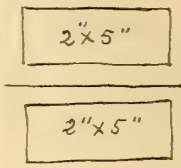


Page 3.



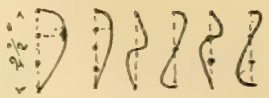
Modify sides and corners, or simply the corners.
Improve. (Dividing etc.)
The 4 corners to be alike.

Page 4.



Modify corners, etc.
Improve.

Page 5.



459.

460.

SLATES OR BLACKBOARD.

Compound reversed Curves.

Some curves have their highest altitude on the middle of their bases: ⌒ ;

others have not: ⌓ . Observe how one end of the 2d curve is different from its other extremity!

A simple curve is struck from one center. The circle and its arcs are simple curves.

A compound curve is struck from more than one center. It would take at least two centers to describe A and B, fig. 459, and 4 centers for C, D, E, F.

A reversed curve even when made of arcs is a compound curve: ∽ . Why?

Describe a simple curve with base and alt.
" " compound " " " " "
" " reversed " " " " "
Close to each curve write its name.

BLANK BOOKS:

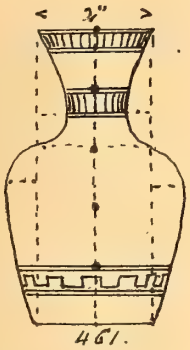
1. Draw L M through center of page.
2. Draw six vertical bases 2½ in. each, not quite one inch apart from one another.
3. Altitude of curve A is ⅓ its base
" " " B " ¼ " "

Bisect C and D. Their altitudes are $\frac{1}{6}$ of the whole base of each.
Trisect E and F. Altitudes, about $\frac{1}{3}$ and $\frac{1}{9}$ of bases.

For fig. 460 draw a $2\frac{1}{2} \times 5$" oblong. Divide height into 6ths. Borders = $\frac{1}{6}$
Width divided into 6ths; thus:

Make all curves exactly alike.

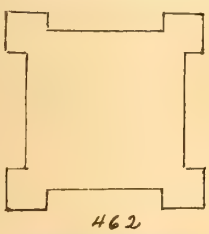
Page 6.



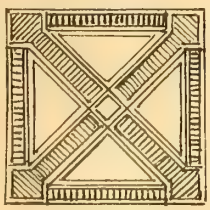
461.

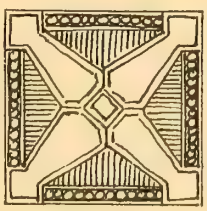
Height = 5". Width = 2".
Upper altitudes = $\frac{1}{2}$".
Lower " = $\frac{3}{4}$"
Note that the ornamental lines appear closer on the left and right sides than in the center of the vase. Why?
Is there any object around to illustrate this?

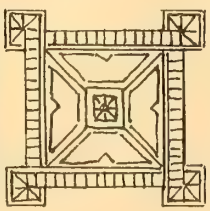
Page 7.


462

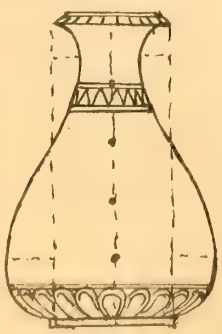
5" square. Divide into 5ths and 10ths
Improve by parallel lines, modifying sides and corners, etc.


463


464

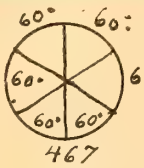

465

Page 8.

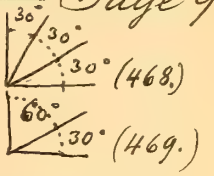

466

Same dimensions as in fig. 461. The altitudes are at different places.
Two horizontal lines are added above and one below the first outlines of the vase.

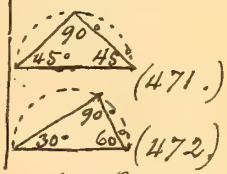
Page 9.



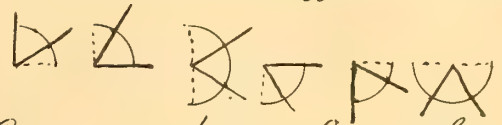
467



470



SLATES.
We know the quadrant, the octant, and the degree. What shall we call a sector equal to one sixth ($\frac{1}{6}$) of the circle? (a sextant.)
How many degrees in the arc, — in the angle of a sextant?
Can you draw an angle of 60°? (See fig. 468 & 469.)
Can you draw 8 angles of 60°, each in a different position?


etc.

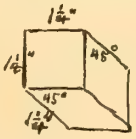
Can you draw 8 angles of 30° each in a different position?


etc.

BOOKS.

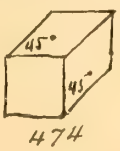
Circles = 2" diam. or 1" radius each.
Draw fig. 467, 468, 469, 470 471, 472.
Write No. of degrees of each angle.
In fig. 467 write 6 times the word sextant within the circle.

Page 10

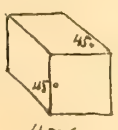


473

475



474



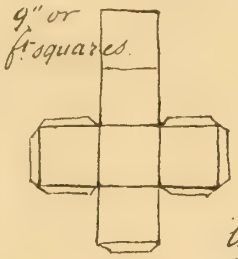
476

Oblique Projections of the Cube.

Preparatory Work.

Place a large cube before the class.
Note. If you have no cube you can make one by cutting a piece of paste board or tin as shown on page 18. It is very desirable to have each pupil provided with 2" or 3" cubes made in the same manner

or cut from scantlings.



477.

Preliminary Work.

The top, bottom, and sides of a cube are called its faces or surfaces; the edges of these surfaces are called lines, and the extremities of these lines points.

The height is the distance between the top and the bottom of a cube. The width is the distance between the left face and the right face. The length is the distance between the front and the back of the cube.

How many faces in a cube?
" " lines " " "?
" " points (corners) in a cube?

Can you see two faces of the cube looking at it from one position?

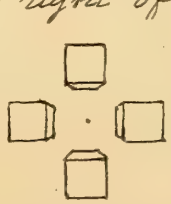
Can you see 3, 4, 5 faces from one view of it?

(Let pupils investigate, using their own models.)

Imagine there is a square board or frame placed upon your desk, perpendicularly to your central ray of vision, the center of this board directly opposite to your eye, thus:

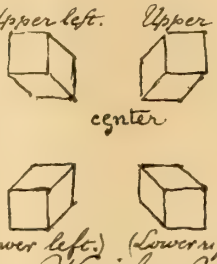
Placing the cube upon the center of this board, with one of its faces parallel to it you will see only one face of the cube: the front.

Moving the same cube vertically above or below, and horizontally to the left or to right of the center you will see two faces of the cube:



Ex.

Placing now the cube successively upon each of the four corners of the board, you will see three faces.



We, generally, draw solids in one of these last four positions in order to show the three dimensions: height, width, and length.

Which faces of the cube do you see when you hold it upon the upper left corner of your imaginary board? (Front, right, and lower faces.)

In what direction do the oblique lines, from the front corners, run? (Towards the lower right corner of the board.)

Which faces of the cube are seen when it is on the lower left corner of board? (Front, upper, right faces.)

In what direction will you draw your oblique lines? (Towards the upper right corner.)

Which faces are seen when the cube is on the upper right corner of the board? (Front, left, and lower faces.)

What is the directions of the oblique lines? (Towards lower left corner.)

Which faces.....on the lower right corner? (Front, upper, left faces.)

Oblique lines run towards upper left corner.

Books.

Divide the page into 4ths
Every line to be 1¼ inches long.
Angles = 45°, 90°, and 135°.
ALL OBLIQUE LINES MUST BE PARALLEL.

Fig. 473.

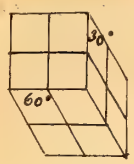
Construct a 1¼ in. square. Leave ½ in. margin from left and ¾ in. from upper edges of the book.

After making square, draw oblique parallel lines; then last two lines, parallel with corresponding front lines.

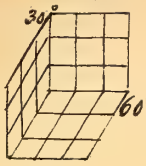
Work in the same manner fig. 474, 475, and 476.

Page 11.

Oblique Projections.

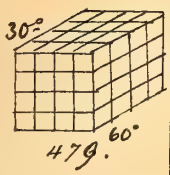


478.

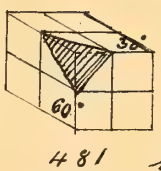


480.

Outlines of cubes = 1¼" each. Draw angles, etc., as shown in fig. 478, 479, 480, and 481. Remember to draw similar lines parallel to one another.



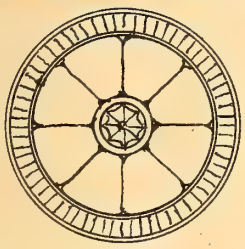
479.



481

Use models.

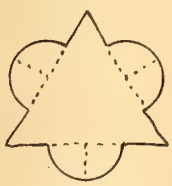
Page 12.


482.

Diameter of circle = 5" or radius = 2½". Border = ⅓ diameter. Center circle = ¼ diam. Border is divided into 64 equal parts; All division lines to be directed towards the center.

Page 13.

For an original design. Base of equilateral triangle = 4". Altitude = 3½". (⅞ of base) Sides divided into 4ths (For Teachers.)


483.

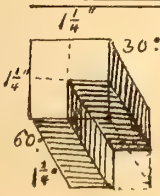

484.


485.

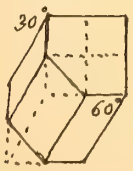

486.

Page 14.

Oblique Projections.

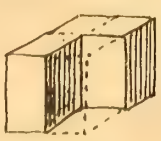


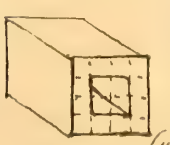
487



488

1. Review last two lessons on this subject.
2. Draw cubes lightly.
3. Divide their faces into 4ths. (fig. 490 into 16ths)
4. Find other lines.

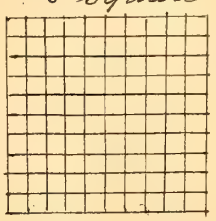

489.


490.

Turn book about to see different views of same section.

Page 15.

5" square


491.

Sides divided into 10ths. 100 squares. Very light lines. You may subdivide still more. Make a symmetrical design. Work on slates first. Select best design for books.

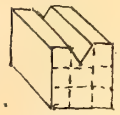
Page 16.

Oblique Projections.


492.


493.


494.


495.

Review preceding lessons on this subject. Outlines of cubes 1¼ in. each. Angles, at will. It would help you much to imagine the cube to be transparent, like glass, permitting you to look through it and to see all its edges and sections. Then making the front and back alike you would have:

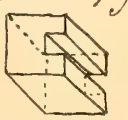

496.

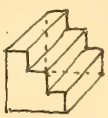

497.


498.


499.

Connecting the corresponding points, front and back, we obtain:





etc; see fig 492, and foll.

"One half the difficulty of these drawings will disappear if the teacher has small pieces of wood properly cut for illustration. With a sharp knife they can be quickly made from soft wood. Every school has its boys skilled in the use of the knife, who would be pleased to prepare the models." .... "There has been, in schools altogether too little education of the hand for the good of the head even." "If the pupil, instead of simply copying the given examples, makes use of models he will not only draw the ex. more readily but will be enabled to draw any modifications which may be required." (Chas. D. Stetson.)

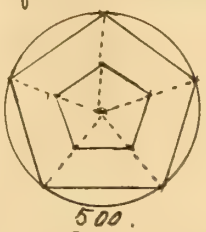
B4TH

New Matter.

1: Dividing circles into 5ths
2: Ellipse, Oval.
3: Isometric Projections.
4: Unit designing.
See directions pp. 2 and 3.
Review "Geometric Terms of 5th and 6th grades.

Page 1

of the "National Blank Drawing Books.



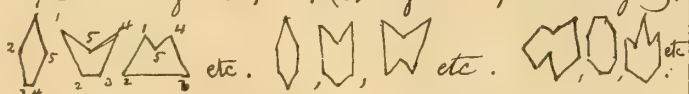
500.

Describe a circle 2½ in. radius. (5" diam.)
2. Upon its circumference, draw 5 dots equally distant from one another.
3. Connect those dots.
4. Draw radii. (dotted lines fig. 500.)
5. Bisect each radius; draw inner pentagon.

Review of Polygons. (many angles.)

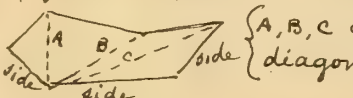
Pentagon = 5 angles.
Hexagon = 6 "
Octagon = 8 "
Polygons are regular and irregular.

Irregular Pentagons; Hexagons; Octagons.



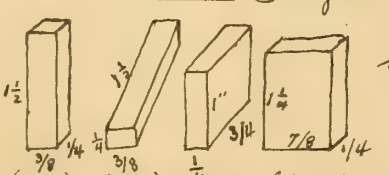
etc. etc. etc.

Diagonal = (from angle to angle.)
(through + angles.)



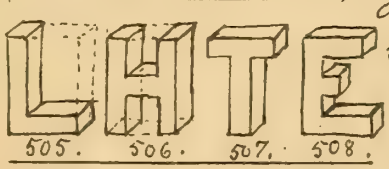
A, B, C are diagonals

Page 2.



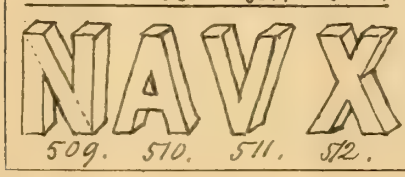
(501) (502) (503) (504)

Review A 5th lessons on the Cube.
Draw two horizontal lines dividing page into 3ds
Block fig. 501, 1½" × ⅜" × ¼".
Angles = 45°.



505. 506. 507. 508.

Block fig. 502
Same dimensions.
Angles 30° & 60°.



509. 510. 511. 512.

Block 503 is 1" × ¼" × ¾". Angles = 45°
Block 504 is 1¼" × ⅞ × ¼ Angles = 45°
All the letters are cut from this last block and are therefore: 1¼" × ⅞" on their faces, and the lines showing their 3d dimension are ¼" each.
Can you draw different views of these letters?
Could you draw letters I, F, K, Y, & Z?

Page 3.

513

Construct a 3" × 4½" oblong.
Draw diagonals, etc.
Inscribe an ellipse
Inner ellipse = ⅓ hight
Practice often off hand
It will improve your penmanship.

Page 4.

UNIT DESIGNING.

Preliminary Work.

By examining carefully any pattern of embroidery, carpeting, wall paper, etc., we shall notice that it is made of a certain element or form, arranged in such a manner as to produce a pleasing effect upon the eye.

A dot, a line, a flower, or a combination of lines, flowers, etc., used in the composition of a pattern, is called a UNIT OF DESIGN.

This unit is the first thing to be selected when we wish to design. Almost any form may be chosen.

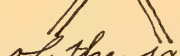
Making units.

Each pupil being provided with two pencils, penholders, straws, wooden toothpicks, or any objects representing two straight lines, will make upon his desk, as many different combinations as he can, and sketch them upon his slate or paper.

To lead the class in this investigation, the teacher will draw a few examples upon the

blackboard; for instance:

Units in different positions are not different units; turning the same pencil in 2 or 3 different positions would not make 2 or 3 pencils.



are four positions of the same unit.

When the pupils have exhausted their ingenuity, the teacher will show how to classify those units: Two lines may be:

1° Parallel: .
2° Making one angle:  .
3° Making two angles: .
4° Making four angles:  .

The slightest change transforms one pattern into another.

The following are the most frequent variations.

(Note. We will use them in all our subsequent lessons in designing.)

1° Changing the position of units.
2° Changing the distance between units.
3° Changing the size of units or of some of their lines.
4° Adding.
5° Subtracting.
6° Changing the angles of units into other angles.
7° (Not to be used at present.) Changing the straight lines of units into curves or vice versa.

Write upon the blackboard, to be remembered by the class:

1° Position.	4° Adding.
2° Distance.	5° Subtracting.
3° Size.	6° Angles.

When repeated a unit is drawn:

1° Along a line, as in a border.
2° Around a center, as in a rosette.
3° To fill an area, as in carpets, dry goods, etc.

Being more easily made, let us begin with borders.

In our lesson, to-day, we will use units  , A, B, C.

Have you seen a border like this  (514)? Where? On what?

Draw it upon your slate, or better, in a book in which you will keep all your designs for future reference.

Could you design another border by changing the position of this same unit?

Ans. 515, 516, 517, etc.

..... changing the distance?

Ans. 518,  519, etc.

..... changing both the direction and distance?

Ans.  (520.)

..... changing the size?

Ans.  521, 522, etc.

Change by adding.

Ans. fig 514  becomes  523.

fig 515  "  (524.)

fig 518.  becomes  525. etc. etc.

It happens often that a pattern cannot be modified in the 6 or 7 different ways given above; as in the case of changing angles, where there is none, or subtracting when there is nothing to subtract from.

The class will try now with the 2d unit:  , keeping in mind the six words: position, distance, size, etc. as they progress in their work.

(For teachers.)

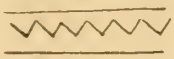
Position.  526 (Parallel lines should be added)

 527,  528,  529

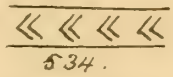
530


531 532 etc.

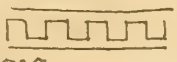
Distance.


from fig. 529.

533


" " 530

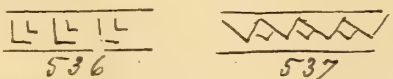
534.


from fig. 528,

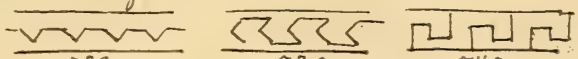
535.

Note here that the same result is often obtained by different means. Compare, for instance fig. 535 derived by "distance" from 528, with fig. 523 made by "adding" horizontal lines to fig. 514.

Size:

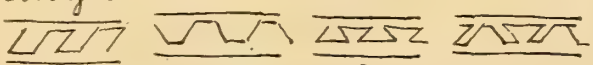

536 537

Adding.


538. 539 540

from 529. from 530. from 527.

Angles.

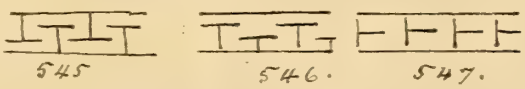

541. 542. 543. 544.

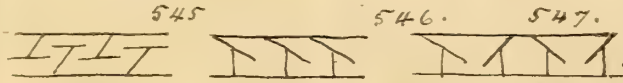
all from 535 above.

Work unit ⊢ in the same manner.

Can you find 5 different borders made with this unit ⊢ ?

Ans.


545 546. 547.

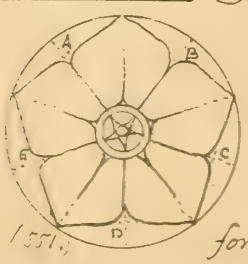

548 549 550 etc.

Books.

Divide the page into 3 equal parts by drawing 2 horizontal lines. Select best three borders made by the class; draw one border in each 3d of page.

Borders = 5" long × .... according to the kind of pattern

Page 5.

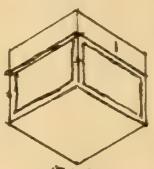

551.

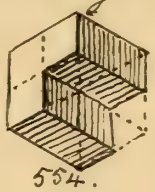
Construct a pentagon within a circle, (-2½" rad.) See fig. 500, p. 20.

Inner circle = ½" radius See fig. 396, page 15. for small curves at A, B, C, D, E.

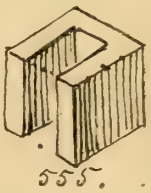
These curves, at A, B, C, D, E, : are wrong, when drawn like this : because, if extended they would cut into the straight lines instead of being tangent as they should be.

Page 6.


552.


554.


553.


555.

Isometric Projections.

In the isometric projections the cube is placed so as to appear to rest upon one of its corners. All its lines would, in the common projections, be equal, (hence isos, equal.) The right angles of the cube are changed into angles of 60° and 120°. The outlines of the whole figure are those of a regular hexagon. The faces of the cube are rhombs.

Books.

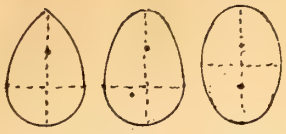
1. Divide page into 4ths
2. Describe a circle, 1" radius, in each quarter.
3. Inscribe a regular hexagon within each circle. In 553 divide horizontal diameter instead of vertical diam. as in the other three figures. (552, 554, 555.)

In fig. 554 divide front and back of cube into 4ths

In fig. 555 divide upper and lower sides into 16ths

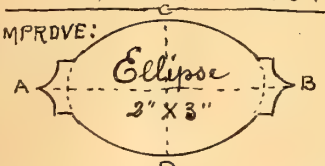
Use models; try to find with them the true isometrical position of the cube.

Page 7.



Vertical lines of fig. 556, 557, and 558 are 2½ in. long. Divide each into 3ds

IMPROVE:



(559.)

Width of each of these figures = ⅓ height.

Describe curves slowly and with one stroke, if possible.

Fig. 559 may be enclosed within an oblong 2"×4", or better, the ellipse 2"×3" may be drawn first and the modifications added afterwards. A to B = 4"; C to D = 2". IMPROVE. Ex.

Page 8.

Unit Designing.

Making units, page 21. Give each pupil materials for three lines. Work with them as recommended on p. 21.

SLATES.

With 3 lines, can you make 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 angles?

Ans. 3 Y, 4 H, 5 ⊣⊢, 6 ⊣H, 7 ⊣A, 8 HH, 9 AA, 10 AA, No 11 ✕, no 12, 13.

Can you make 5 more figures like ⊔, by simply changing its angles?

Ans. 1 ∠, 2 ⊔, 3 ⊔, 4 ⌓, 5 ⌒.

Change the angles of H.

Or. H, H, H.

Change angles of ⅂.

Z ⌒ V ⅂

Make one border with ⊔.

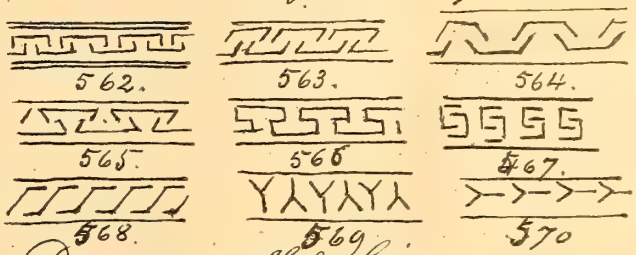
Another with unit H.

A 3d " border with unit ⅂.

Draw best borders upon blackboard.

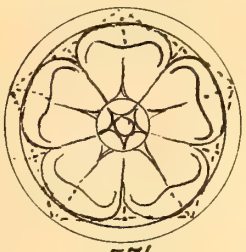
BOOKS.

Select best three borders and draw them in the blank books. (Ex. in case of need.)



Draw parallel lines.

Page 9.

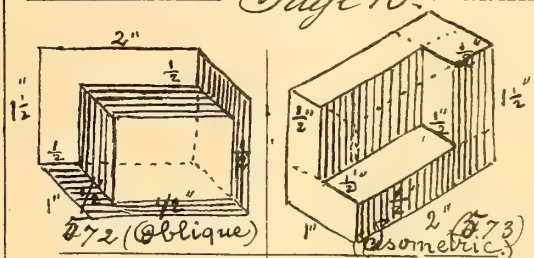


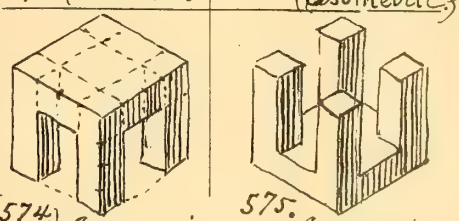
571.

1° Copy fig. 551.

2° Add:

Page 10.

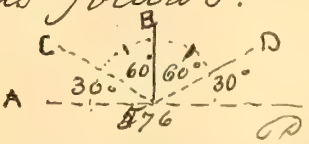




Dimensions of Nos. 472 and 473 are 1"×1½"×2".

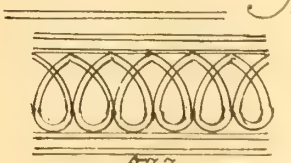
Angles of 45° and 60° Sections ½" in depth.

It will be well, in all the isometric projections, to start as follows:



Draw line A, then B, C & D in succession.

Page 11.



577.

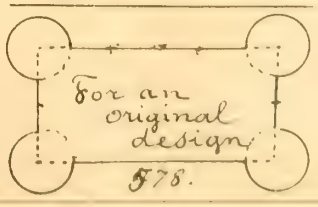
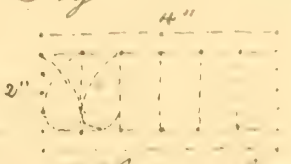


Fig. 577 is 2"×4".



Oblong of fig. 578 is 2"×4". Radii of circles = ½ in.

If pupils have received the proper training, they will have no difficulty in improving fig. 578. Otherwise let them review: Dividing areas pp. 13 and 14. Modifying middle of lines, p. 14; to which may be added parallel lines, and any little ornament they may be able to draw.

Page 12.

Unit Designing.

See pp. 20, 21, & 22.

Each pupil should have:
1° Materials for two lines +
2° At least four pieces of paper cut in △.

Write upon the blackboard:
Position. Distance. Size. etc.

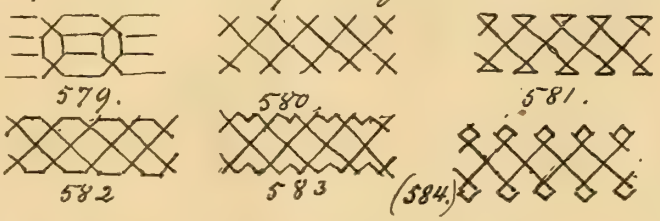
– BOOKS –

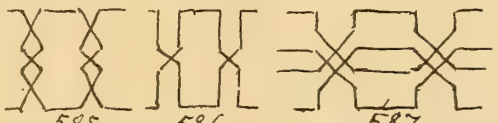
Draw 3 borders with units + and △.

(For teachers.)

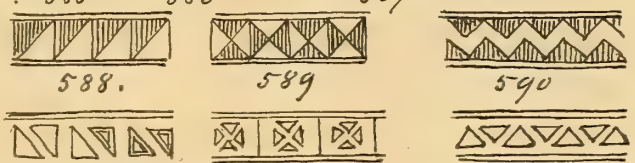
Making units: +, X, X, X, etc. △, ◁, ▷, etc.

Borders: See p. 14 for unit +.



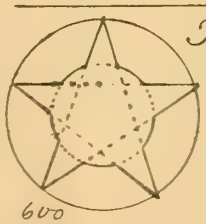


etc, etc.



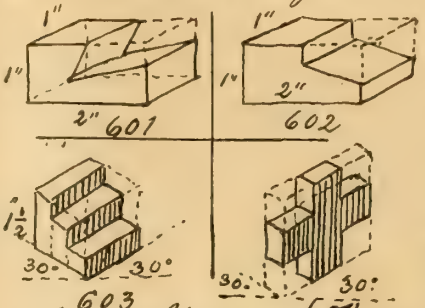
etc. etc

Page 13.



Improve. Circles 2½" and 5" in diam. or 1¼ and 2½ radii.

Page 14.



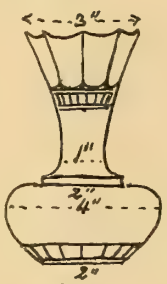
Blocks 601 & 602 = 1" × 1" × 2" each. The sections may be more or less accurate provided they show the kind of scarfing used here.

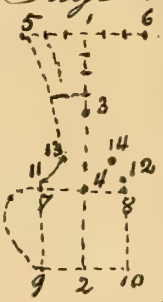
Could the boys make models (of 601 and 602,) enough for the whole class? or at least cut a few large ones for the teacher's table?

Work 603 as you did on p. 19, except that your angles are here of 30°, 60° and 120° instead of 90° etc.

The cross is cut from a block 1½" × 1½" × ⅜". Divide square faces of block into 9ths and leave off the small square at each corner.

Page 15.





Line 1-2 = 6" divided into 3rds.
Line 5-6 = 3"
Lines 7-8, 9-10, & 11-12 = 2" each
Line 13-14 = 1"

Draw curves on left side, then those on the right of central line 1-2.

See Note p. 17, fig. 461.

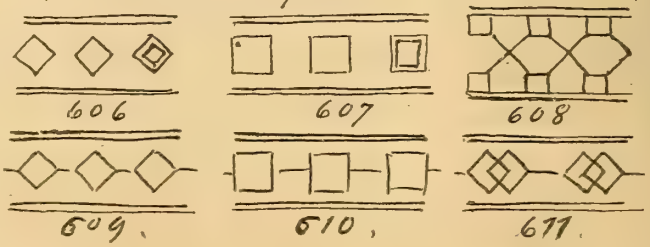
Page 16.

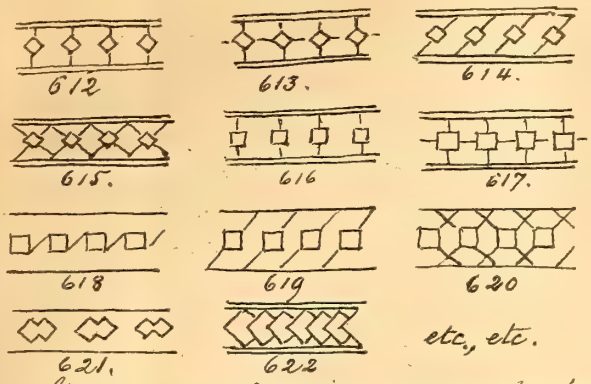
Unit-Designing.

Each pupil should have 5 or 6 □ and as many ▭ to combine with.

You cannot change the angles of the square and of the oblong.

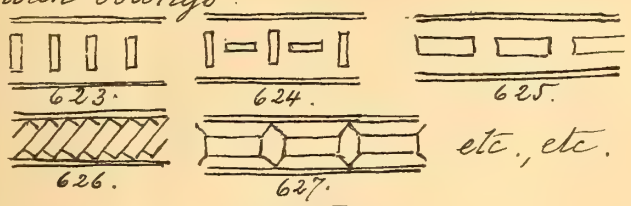
Ex. on the square.





etc., etc.

Similar combinations may be drawn with oblongs.



etc., etc.

A 4TH.

New Matter. 1° Double Segments. — 2° Spirals, — 3° Mouldings — 4° Projection and Unit Designing continued.

Directions pp. 2 and 3.

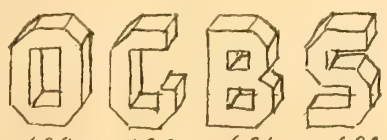
Review "Geometrical Terms pp. 8, (B 6th.) 11, 12, 13, 16, 17, and 20.

Page 1,

NATIONAL BLANK DRAWING BOOKS.

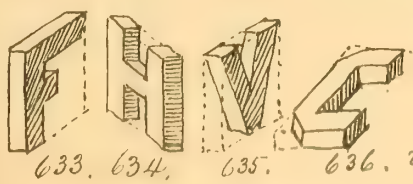
Describe circle (2½" rad.) Note. We have divided circles into 3, 4, 5, 6, and 8 equal parts. Let us try now to divide them in parts a little more or a little less than 3ds 4ths, 5ths, etc.

Page 2.

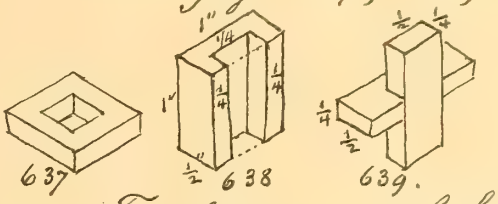


Divide this page into 3ds

Draw OGBS in the upper, and FHVC in the middle thirds. In the lower 3d

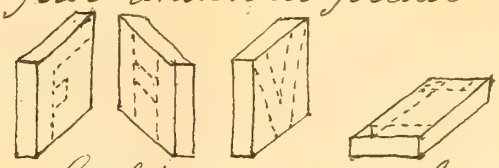


draw fig: 637, 638, and 639.



The letters are of the same size as on p. 20. (= 1¼" × ⅞" × ¼.)

For F, H, V, C the blocks are first drawn as follows:



Could you draw letters D, J, P, Q, R, U, M, and W? The last two 1⅛" wide instead of ⅞". Could you draw these letters and those on p. 20 in other positions?

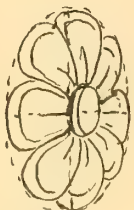
Fig. 637, 638 and 639 are drawn in isometric projections. Begin them with 30° ↓ 30°. See fig. 576 Page 23.

Dimensions: fig. 637 = 1" × 1" × ¼" with a small square in center = ½ × ½ × ¼.

Fig. 638 = 1" × ½" × 1". The section is 1" × ½ × ¼.

Fig. 639 = 1" × ½" × ¼ each board. The upright board is ¼" into the other.

Page 3.



Describe a 3" × 5" ellipse.

Describe a small ellipse on the right of center.

Divide both into 8 irregular parts, as shown in fig. 640.

Page 4.

DESIGNING.

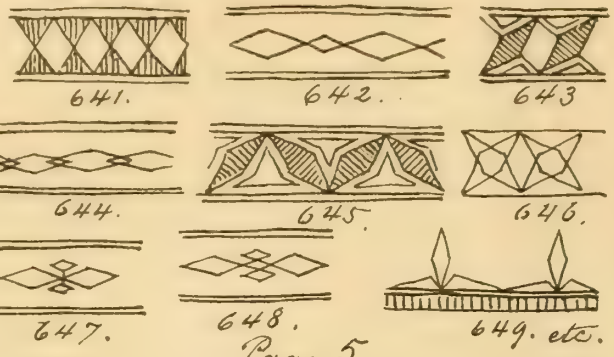
Unit of design = ◇ (Rhomb.)

Give each pupil 6 to 8 paper rhombs.

Let them find units and make designs on slates or practice paper.

Write upon blackboard: Position, Distance, Size, etc. (Page 21.)

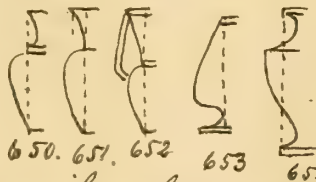
Select best two or three original designs to draw in the books.



Page 5.

SLATES.

These five outlines,



being drawn upon the blackboard, let each pupil select one and make, upon his slate, a vase 5" high.

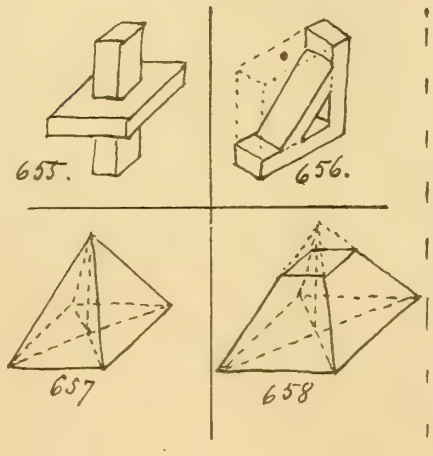
When his sketch is satisfactory to the teacher, he may be allowed to draw the same in his book.

Let him draw the left side of his vase first, then, the right side should be made as nearly alike as possible.

Laughing at the trials of pupils doing their best in this exercise would be one of the surest means of disgusting them with drawing.

See directions 5 and 8, page 2.

Page 6.



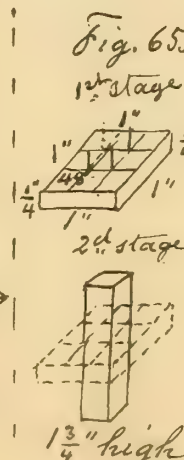


Fig. 655.

Fig. 656.

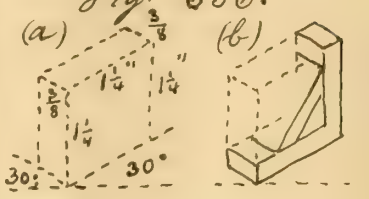


Fig. 657.

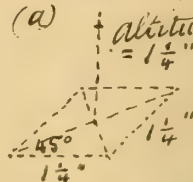
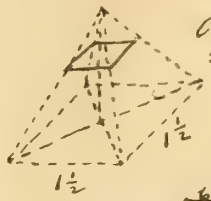
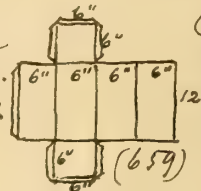


Fig. 658 same as 657, except

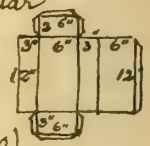


Patterns for making models. (For class use.)

Square prism. 6" x 6" x 12".



Rectangular Prism. = 3" x 6" x 12".

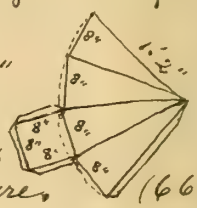


See Prisms and Pyramids p 30

Square pyramid.

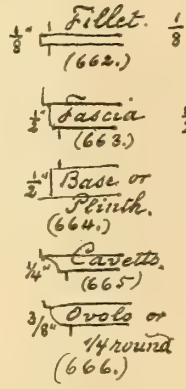
Describe an arc, 12" radius.

Set off four 8" chords and construct a square, as shown in fig. 661.



Show, with models, the difference between prisms and pyramids.

Page 7.



Horizontal lines of moulding = about 1" each. The height of each moulding is written opposite its face. The short lines, above and below each moulding, are about 1/8" each.

Write the names neatly.

Find out which mouldings are used in and about the school. Look at the desks, tables, doors, windows, posts, fences, furniture, cornices of libraries, houses, etc.

Do not draw cavetto , and cyma reversa 

Page 8.

Designing.

Unit: ▱ (Rhomboid.)

Remember directions for designing

1° Giving 4, 6, or 8 pieces of paper (or other materials representing some unit) to each pupil.

2° Making with these forms new units, if possible.

3° Working these units according to variations:

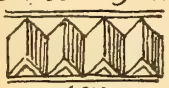
Position. Distance. Size. Adding. Subtracting. Angles. (See p. 21.)

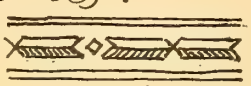
4° Pupils sketching their original designs upon the blackboard.

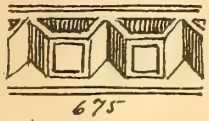
5° Selecting best designs to be drawn in the blank books.

Ex. on the rhomboids.

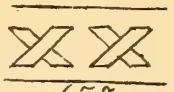

672.


673.

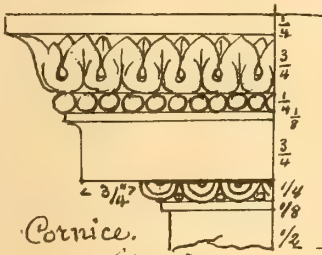

674.


675


676.

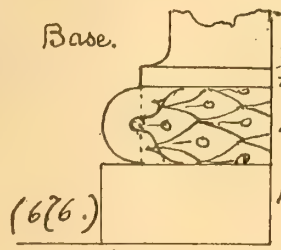

677. etc.

Page 9.



Cornice.
(675.)

	Heights.	Widths.
Fillet.	1/4"	5"
Cyma recta	3/4"	4 1/4"
Astragal	1/4"	4 3/8"
Fillet	1/8"	4 1/4"
Fascia	3/4"	4 "
Ovolo	1/4"	3 1/4"
Fillet	1/8"	3 "
Wall	1/2"	2 7/8"
Total	3"	



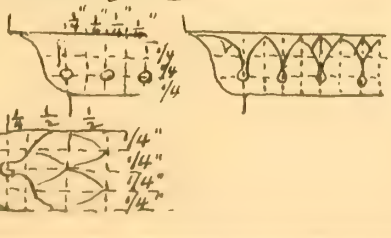
Base.
(676.)

Wall	3/4"	2 7/8"
Fillet	1/4"	3 1/4"
Torus	1"	3 3/4"
Plinth	1"	3 3/4"

Do not copy table of heights, & widths.

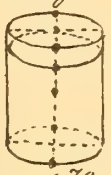
Make mouldings of the size indicated by the table.

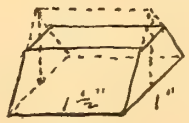
Details of Cyma recta and Torus.



Page 10.

677


679.



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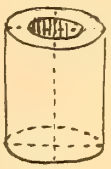
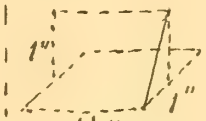

680.

Fig. 677 and 678 have each a base 1½" × 1". altit. = 1"



In 678, draw lines, for section, parallel to corresponding lines of base.

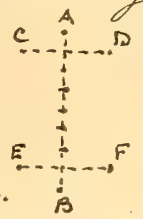
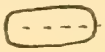


Fig. 679 and 680.

AB = 2"

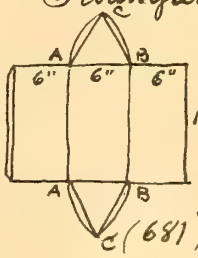
CD } = 1¼" each.
EF }

Divide AB into 8ths

In drawing ellipses avoid  and 

Patterns for models.

Triangular Prism.

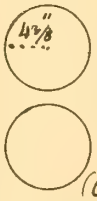


(681)

Draw oblong 12" × 18". Divide 18" into 3ds. From A as a center describe arc BC; from B as a center describe AC. Connect AC, CB.

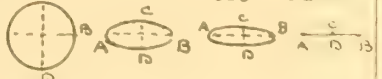
Cylinder.

Radius of each circle = 4 3/8



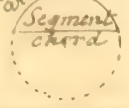
(682)

Using the ends of the cylinder or a hoop, show the class that a circle has the appearance of a circle only when the eye is directly opposite its center. When it is viewed obliquely it takes the form of an ellipse: the small axis appearing smaller and smaller until the ellipse is seen as a straight line.

ex. 

Page 11.

DOUBLE SEGMENT. A segment is a figure bounded by an arc and its chord



Show the difference between a sector and a segment.

A segment equal to a half circle is called a semi-circle.

When two circles are intersecting each other they make a double segment.

Describe 3 half circles. Write in each a different and yet an appropriate name. Ans.

Semi Circle. Sector. Segment.

Books.

Oblongs 683 & 684 = 2" × 5.

Divide height into 4ths

Bead mouldings = ¼ height each.

Divide length of each figure into 6ths

Fig 683

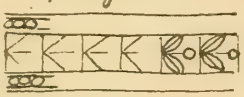
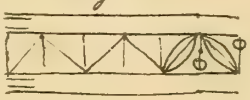


Fig 684.

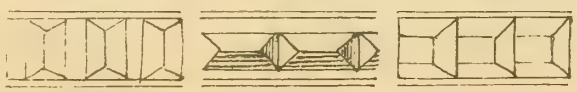


Page 12.

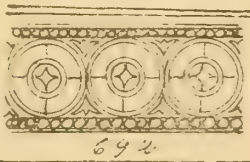
Designing.

Units: ▭, ▱, etc. (Trapezoids.) See "directions" at beginning of p. 27.

Ex. on Trapezoids



Page 13.



Oblongs = 2" × 4½" each.

Circles = ¾" rad. each.

Draw diagram 693, then smaller circles, etc in fig. 692.

Improve fig. 693.

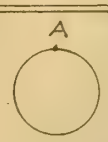
Try on slate first. Fig. 693 improved.

Page 14.

Pattern for a Cone.

1° Cut a circle, 4" radius.

Upon its circumference mark point A.

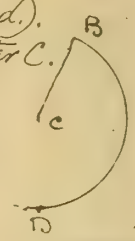


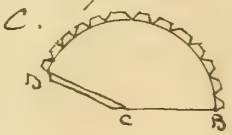
2° Describe an arc (1½" rad.).

Connect point B with center C.

3 Arc BD must be equal to circumference of circle A.

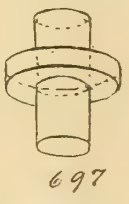
To obtain this: placing A upon B, revolve the circle upon the arc, until A comes again in contact with the arc. Call that point D and connect it with C.

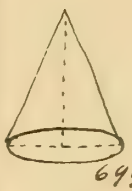




1696.

Books.





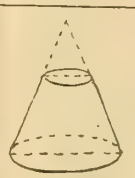


Fig. 697.

Large ellipses = 1½" × ½".

Small " = ¾" × ¼".

Heights ¼" and 2".

(a) (b)

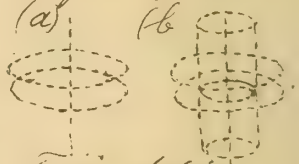


Fig. 698.

Begin as in fig. 679, p. 27.

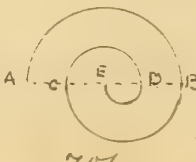
Fig. 699. Ellipse = ½" × 1½".

Altitude from center of base = 2½".

Fig. 700. Repeat last. Draw an horizontal line for another ellipse at about ⅔ altitude.

Page 15.

Practice on Spirals:



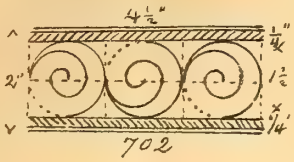
701.

Divide a line into 4ths or any other fraction. Describe a semi-circle from A to B, others from B to C, C to D, and D to E.

Practice in all positions and

directions; ex. , etc.

Books.



702

703.

Fig. 702. Copy fig. 693. Change into spirals.

Fig. 703. = 2½" × 4½" Upper and lower bands = ½" each, leaving 1½" in the middle.

Other directions p. 23, fig. 577.

Page 16.

Designing.

Units: , , (Trapeziums).

See directions p. 27.

See fig. 216, 245, 248, 250, 255, etc.

Diagrams of 45 dots p. 10, give a great variety of trapeziums

B 3D.

New Matter.

Model Drawing.

Unit Drawing. (Continued.)

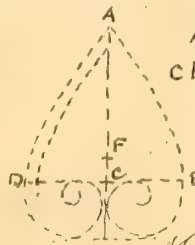
Orthographic Projection.

See "General Directions" pp. 2 & 3.

Review Geometrical Terms pp. 8, (B 6th) 11, 12, 13, 16, 17, 20.

Page 1.

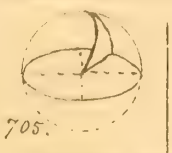

704.



AB = 5½".
CB = 1½".
DE = 4"
CF = ¾".

Draw light and bold lines. Move your wrist.

Page 2.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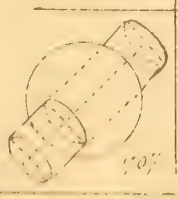
706


707.

708.

Fig. 705. Circle = 1" radius. Ellipse = 1" × 2".

Fig. 706. Ellipse = ½ × 1½". Altitude of cone = 1¾". Cylinder = about ½ to ½ altitude.

Fig. 707. Circle = 1" radius. Ellipses = ½" × 1" each. Cylinder = any length.

Fig. 708. (Isometric) Square block = ¼ × 1¼ × 1¼. Cylinder: Height = 1½". Ellipses = ½ × 1" each.

Page 3.


709.

Diam. of outer circle = 4½"; of inner circle = 3"; of excentric circle = 1½".

Page 4.

Designing.

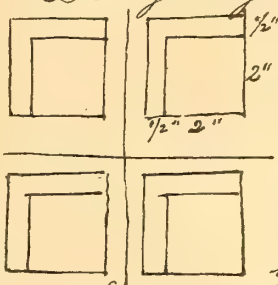


Fig. 710.

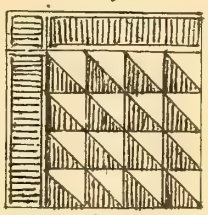
See Directions p. 27.

Draw four 2½" squares. Leave ½" border as shown in fig. 710.

Divide into any number of parts.

Use any unit or units of A & B 4th

Examples for blackboard.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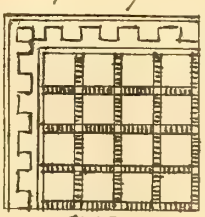
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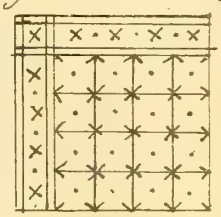
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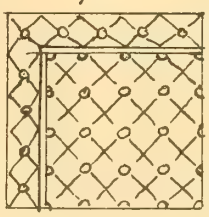
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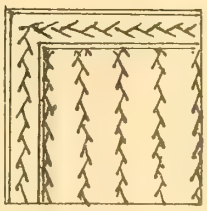
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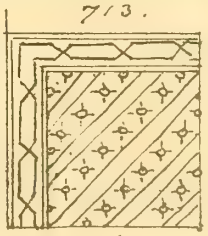
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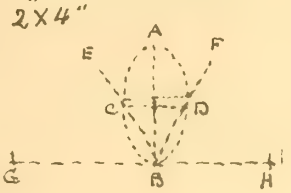
Page 5.



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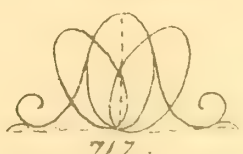
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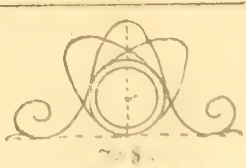

718.

Fig. 717. AB = 2"; GH = 4"; CD = ; BE = 2"; BF = 2"

Fig. 718. AB = 2" divided into 3ds. EF = ⅓ of AB. Divide circle into 8ths GH = 2". HI = 2"

Page 6.

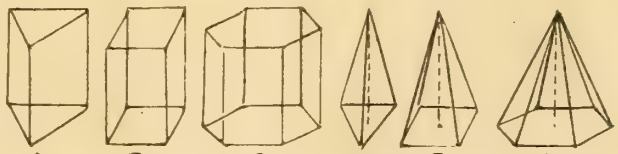
Prisms and Pyramids.

A prism is a solid whose bases or ends are any similar, equal, and parallel plane figures and whose sides are parallelograms.

A pyramid has any polygon for its base and triangles for its sides.

Prisms and pyramids are triangular, quadrangular, pentagonal, hexagonal, etc., according to the kind of polygons they have for bases.

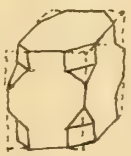
All simple solids may be classed as prisms or pyramids. The cube is a prism with equal edges.

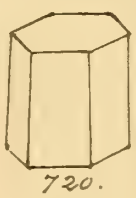


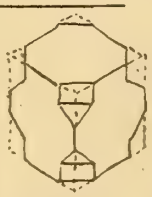
Prisms: A, Triangular; B, quadrangular; C, hexagonal
Pyramids: D, . ; E, " ; F, " .
A prism with a circle for bases is a cylinder
A pyramid " " " " base is called cone
A sphere is a solid bounded by a surface every point of which is equally distant from a point within called the center

Books.

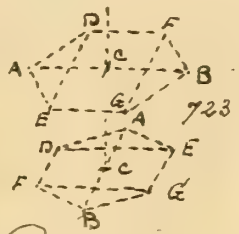

719.


721

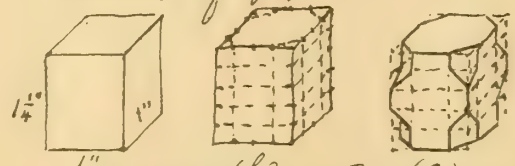

720.


722.

How to draw hexagonal bases:

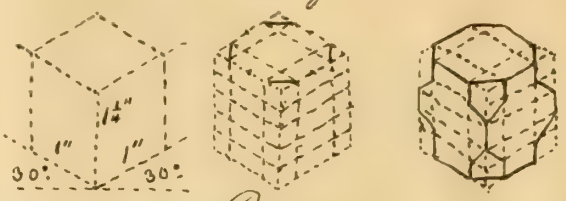


Divide AB into 4ths
Draw DE and FG parallel to each other and at acute angles with AB.
DF and EG parallel to AB.
Details of fig. 721.



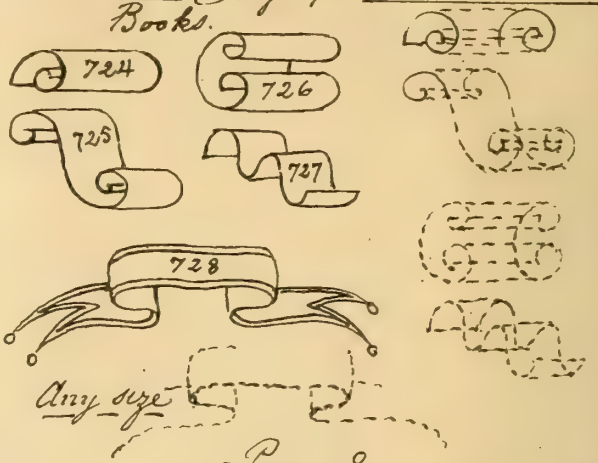
Oblique Projections.

Isometric Projections.



Page 7.

Books.



Page 8.

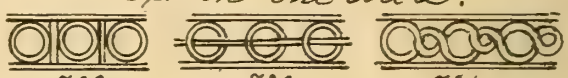
Original Designs.

Draw on slate or practice paper 1, 2, 3, or 4 original designs.

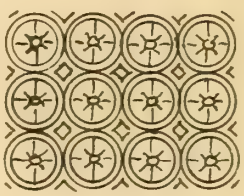
See directions p. 27.

Units. Circle, segment, ellipse, and egg oval.

Ex. on the circle.


729. 730. 731.

Areas.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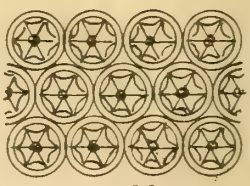
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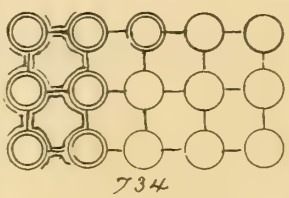
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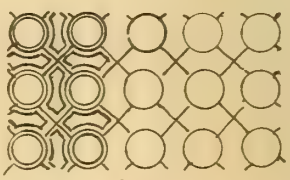
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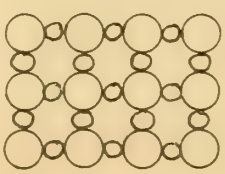
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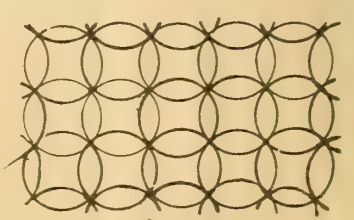
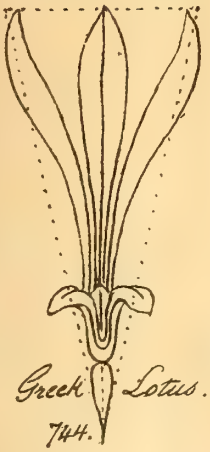

737

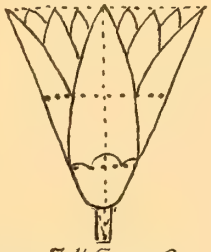

738 739. 740. 741.
742 743.

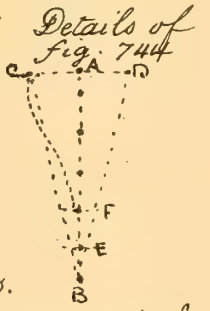
etc. etc.
Copy 2 or 3 ex. into the BOOKS.

Page 9.

Fig. 744 = 2½" × 7½".
Fig. 745 = 2½ × 3"


Greek Lotus.
744.


745
Egyptian Lotus.



BE and EF = 1" each.

Page 10.

Model Drawing.

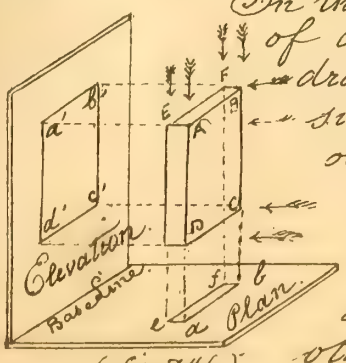
Orthographic Projections.

Give each pupil a block having three different dimensions, as ½"×1"×2", or 1"×1½×3, etc.

Model in hand, review Oblique projections, pp. 17 and 18, and isometric projections, p. 22.

These projections are more or less pictures of objects. Orthographic projections are not pictures but represent objects exactly as they are. When drawn to scale, they become working drawings, and objects can be constructed from them of the exact shape and size required.

In the construction of orthographic drawings: 1° we suppose the object placed between two planes which are at right angles to each other. (See fig. 746.)



(Fig. 746.)

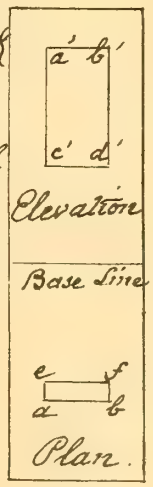
2° From each point (or line) of the object, we send a perpendicular projection to each plane: for instance:

Supposing ourselves at a distance in front of block A B C D, fig. 746, and looking in the direction of the horizontal arrows, we draw lines A a', B b', C c', D d' perpendicularly to the vertical plane. Connecting a', b', c', d' we call this drawing the elevation of block A B C D.

Similarly, looking from above we draw lines A a, B b, F f, E e, perpendicularly to the horizontal plane, and figure a b f e is called the plan of that block.

747.

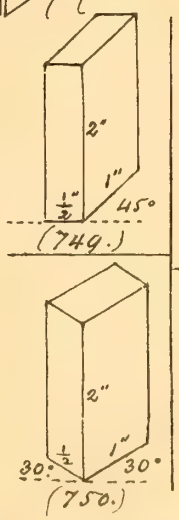
Should we, now, take away the block A B C D and let the horizontal plane assume a vertical position under the other plane, we would have fig. 747; or facing the planes, fig. 748.



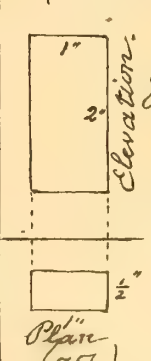
748.

Books.

Block = ½"×1"×2",



(749.)



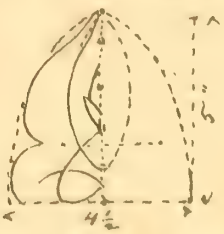
(751.)

(750.)

Fig 749 is an oblique projection. fig. 750 an isometric projection and 751 orthographic projections (or working drawings) of this block.

Page 11.


752



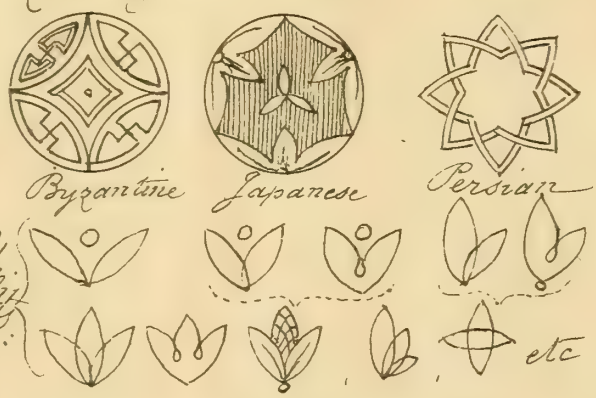
Moorish Ornament - 4½" × 5".

Page 12.

Designing. Directions p. 27.
1, 2, 3, or 4 original designs to be made and afterwards copied into the books.

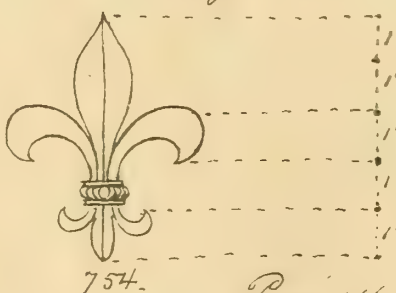
Unit. Double Segment.

Nature is using this form most extensively in leaves, flowers, fishes etc. Can you draw a natural leaf of this form? Find one & draw it.



753.

Page 13



754.

Page 14.

Model Drawing.

Suggestions.

1° Do not try to teach model drawing without models: it would be a loss of time.

2° Each pupil should have his model: two or more pupils cannot use the same model conveniently.

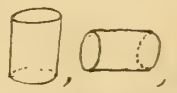
3. Each model should be drawn in the following projections:
(a) Oblique; (4 different views.)
(b) Isometric; (2 " " .)
(c) Orthographic (plan & elevation.)

4. When two or more models are given for one lesson, practice with as many as possible, but you are not obliged to draw them all in the books. One model will be enough. Make one drawing of that model in each of the three different kinds of projections.

1st model. A cylinder.

Note. It can be made of wood, chalk, a rolled piece of paper, etc.

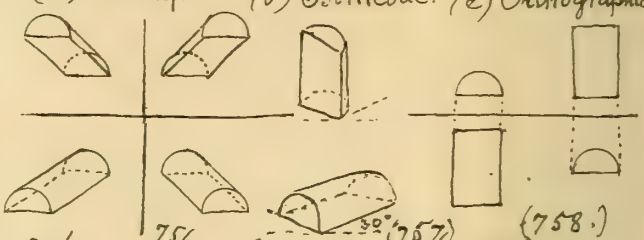
Ex. of Oblique and Isometric projections.



Orthographic Proj.

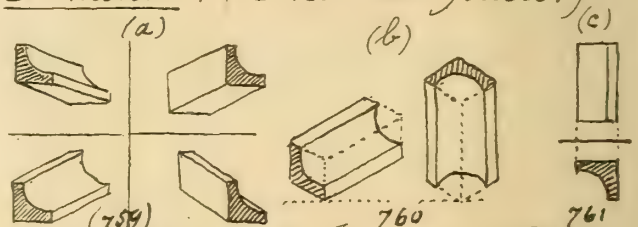
755.

2d model: (Astragal.)
(a) Oblique. (b) Isometric. (c) Orthographic.



756. 757. (758.)

3d model. (Cavetto and fillets.)



759. 760 761

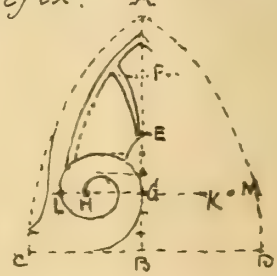
(a) Oblique. (b) Isometric. (c) Orthogr...

See Note for fig. 765, p. 33.

Page 15.

Antefix.

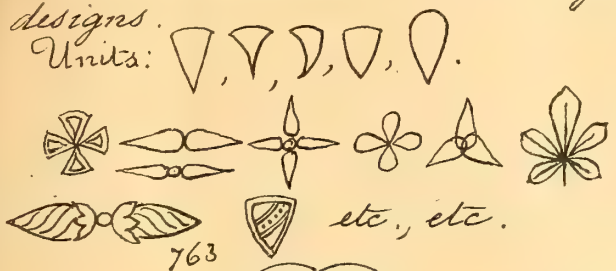
762.



AB = 4"; CD = 4"; AF, FE, EG, GB = 1" each; LM = 3"; HK = 2".

Page 16.

Designing. Directions p. 27.
Draw on slates and afterwards into the blank books 1, 2, 3, or 4 original designs.
Units:



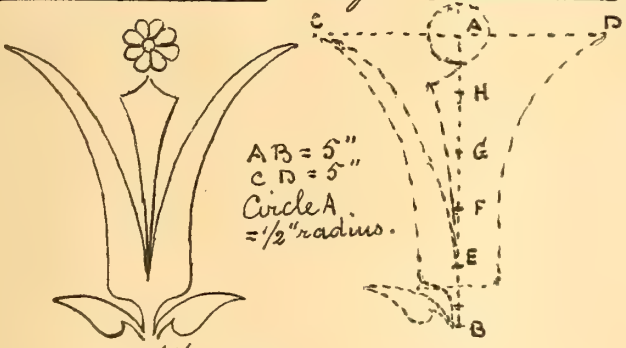
etc., etc.

763

A 3D.

Continuation of B 3D. Work.
Directions pp. 2 and 3.
Geometrical Terms: pp. 8, (13 6th) 11, 12, 13, 16, 17, 20, 28, 30,

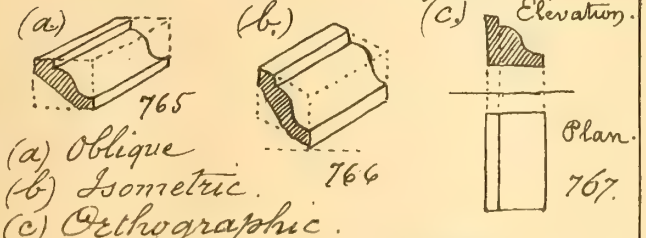
Page 1.



764

Page 2.

Model Drawing. — Projections
See pp. 31 and 32.
Model: Cyma and fillets.



765 766 767.

(a) Oblique
(b) Isometric.
(c) Orthographic.

Note. Mouldings can be obtained at very little cost. Cut them in 2" or 3" pieces.

Page 3.

768.

4½" square.

Page 4.

Designing. Directions p. 37.
Draw 1, 2, 3, or 4 original designs into the blank books. Practice 1st
Units: (, C, C, C. in connection with any unit used heretofore.

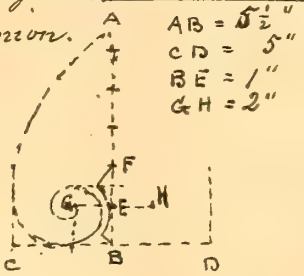
etc

(769)

Page 5.

Anthemion.

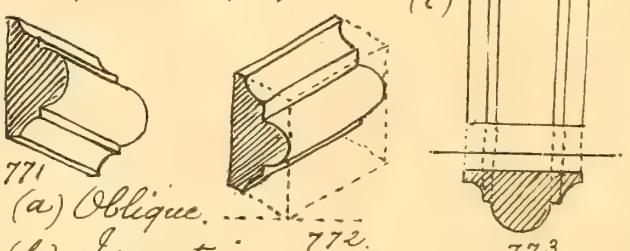
770



Page 6.

Model Drawing. Projections.
See pp. 31 and 32.
Model: Moulding:

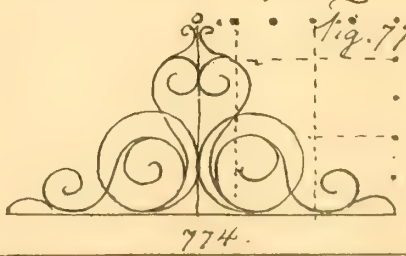
(a) (b) (c)



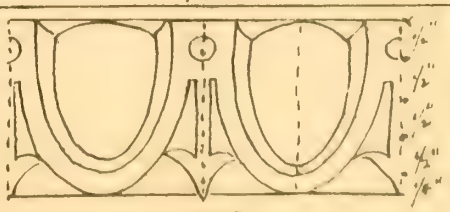
771 772. 773.

(a) Oblique.
(b) Isometric
(c) Orthographic.

Page 7.



774.



775.

Fig. 775 = 2¼" × 5"

Page 8

Designing. Directions p. 27.

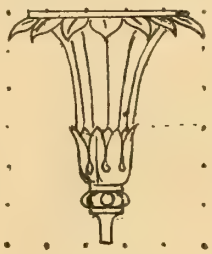
Books. Draw one or more original designs made principally with units ∫ and ◎

For spirals, bend pieces of thin wire. Make some models smaller than the others.

Pupils may copy scroll brackets, wrought iron fences, etc. They should not trace from flat copies.

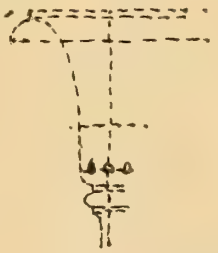
Whenever it is a copied and not an original drawing it should be so stated, writing under it: Copied from .....

Page 9



776.

5"×6".



Page 10

Model Drawing.

See lessons on this subject pp. 31, and foll.

Draw one or more common objects: a tumbler, a cup, a vase, an inkstand, a bottle, etc, etc, (Nothing too complicated.)

Do not allow the use of flat copies

Draw at least one ex. in common or orthographic projections.

Page 11

777.

Diam = 4½"
Border = ¾"
Divide circle into 32ds.

Page 12

Designing. Directions p. 27.

Use any straight lined unit. Make a simple and neat original design with it.

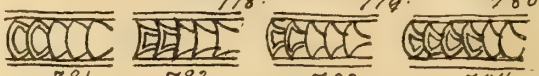
Find in how many ways you can alter your pattern by changing some or all the lines into curves.

Ex. Unit: ⊏

Pattern:

Changes:

778. 779. 780

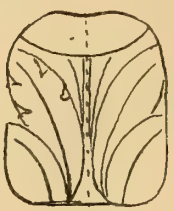


781. 782. 783. 784. etc.

Page 13.

4"

4"×5"



785. Acanthus Leaf.

Page 14

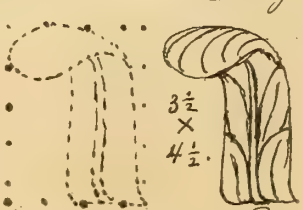
Model Drawing.

Orthographic Projections.

Make a rough sketch of a common object, such as:

Plan & elevation of school bell.
" " " " " drum.
Plan of school room.
Elevation of teacher's table.
" " side of a desk,
" " gate post.
" " stove, piano, book-case, etc, etc.

Page 15.



3½ × 4½.

786

Side view of an Acanthus Leaf.

Page 16.

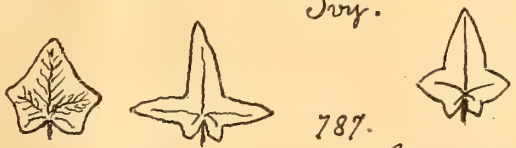
Designing.

Conventional forms are modifications of natural forms: a retaining of their general features, without imitating

their individual peculiarities.

The rule is to omit everything which can be omitted and still express the leading peculiarities of the object represented.

Ivy.



787.

Natural. Conventional.

Unit of Design:

A clover leaf, an ivy leaf, or any other leaf or flower of simple form.

1° Require each pupil to bring several specimens of the selected unit.

2° Conventionalize it.

3° Treat it according to position distance and size.

4° Repeat it along a line, around a center or to fill an area.

5° Sketch best original designs upon blackboard.

6° Select the best for books.

N.B. In designing bear in mind. 1° Symmetry, 2° Proportion, and 3° Simplicity. Make it a rule to err on the side of simplicity rather than on that of elaboration.

B 2D.

INSTRUMENTAL DRAWING.

Materials

Compasses. — Ruler. — Draughtsman's scale. — Smith's school Square. — A very hard pencil. — Practice paper of any kind.

Summary. Use of instruments. — Point. — Circle. — Parallel lines. — Perpendicular lines. — Dividing lines, arcs, and circles. — Applications.

Note. Such problems as are explained in all elementary geometries are not solved in this course of study. (See Bartholomew's Books, Nos 7 and 8, old edition, or Nos. 14 & 15, new series.)

Point.

A mathematical point has position, but no magnitude (See Dir. 6, p. 2.)

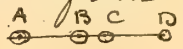
Points not being visible, we use dots. Make dots as small as possible.

The place where two lines meet or cross each other is called a point. Except in this last case, surround points with small ○, △, □, ⌒, ∧, etc.

Ex. ⊙ □

△ ⌒ △

Letters (A, B, C, etc.) or figures (1, 2, 3, etc.) are used to distinguish one point from the others. Ex.



△1 3△ △2 4

' means ft ex. 1', 16', 7', etc.

" means in " 4", 9", 7"

2'.4" 5'.8" etc.

< > mean from, (or) to.

Ex A <- - - 6'.5" > B

From A to B = 6ft. 5 in.

Problems.

(1.) To draw 4 points, with letters &c.

(2.) To write ', ", < >, and the meaning of each.

(3.) To draw a line through two given points

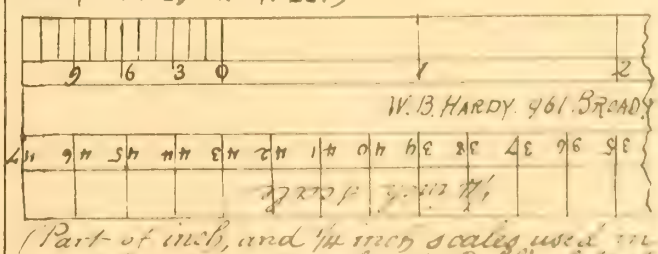
Scale.

"In geometrical drawing, a scale is understood to be a contrivance by which any small distance, as an inch, for instance, is taken to represent some, or any one, of the ordinary units of length, as a foot among mechanics, or a chain among surveyors." (S.E. Warren.)

Take up the side of your scale having inch divisions.

Remember that each of these inches on your scale represents one foot.

(4.)(a) To set off along a line: 1', 2', 4.



(Part of inch, and ¼ inch scales used in Oakland Public Schools.)

Notice that the ft. are the (inch) spaces on the right of 0 line (*); while on the left of 0 line are $\frac{12}{12}$ of a foot, or small divisions representing inches.

Count spaces and not lines.

Begin to count from 0 line.

(b) To set off along a line: 3", 6", 9".

(c) " " " " " " 4", 5", 7", 2", 8", 11".

(d) " " " " " " 1'3", 1'6", 1'9".

(Count ft. on the right and in. on the left of 0 line.)

(e.) " " " " " " 2', 2'3".

(f.) " " " " " " 1'2", 2'5", etc.

Can you draw, with the same scale, lines representing the real dimensions of: (a.) your desks?

(b.) books; boxes?

(c.) teacher's table; chairs; benches?

(d.) widths of doors; windows?

(e) heights of blackboards, maps, panels, etc.

(5.) To set off equal lengths upon a line. (Use scale, and also dividers.)

Ex. A B C D E L M N O P

< 4" × 4" × 4" × 4" > < 3" × 3" × 3" × 3" ×

a b c d e f g etc.

< 2" × 5" × 2" × 5" × 2" × 5" >

(6.) To draw a line of any length and to measure it with the inch scale.

CIRCLE.

(7.) (a) To describe a circle of a given radius. (7"; 9"; 1'; etc.)

(b) To describe an arc with a given radius.

(c) To describe intersecting circles (or arcs) with given radii.

(Give 2 equal, and 2 unequal radii.)

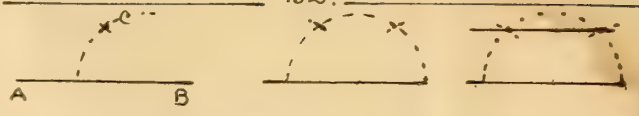
(d) To describe, with given radii, two or more concentric circles; — two or more parallel arcs.

PARALLEL LINES.

(8.) To draw a line parallel to a given line at a given distance from it.

Can you draw, one inch to a ft. scale, two parallel lines representing the real distance between the left and right sides of your desks? — between front and back of the same?

(9.) To draw, through a given point, a line parallel to a given line.



PERPENDICULAR LINES.

(10.) To bisect a given line; or To erect a perpendicular upon (or through) the middle of a given line.

(11.) At any point of a given line to draw a perpendicular to the line.

(12.) From a given point without a given line, to let a perpendicular fall to the line.

(13.) To erect a perpendicular at the extremity of a given line.

(14.) To construct a square upon a given base.

(15.) To construct an oblong of given dimensions.

Scale: $\frac{1}{12}$. Construct oblongs showing (by scale) the real dimensions of:

top of your desks; — panels; — sides of boxes; — books; — panes of glass; etc., etc.

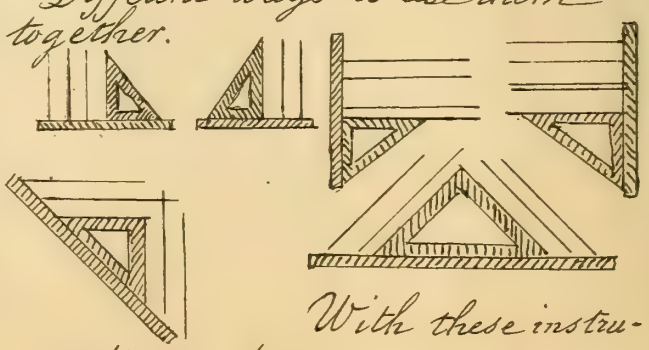
(16.) To find the center of a square; — an oblong.

(Ans. Draw diagonals.)

Find the centers of the oblongs you have drawn already.

RULER AND SQUARE.

Different ways to use them together.



With these instruments, we draw:

1º Perpendicular lines.

2º Parallel lines.

3º We divide given lines into equal and proportional parts.

With ruler and square, draw over again probl. 8, 9, 11, 12, 13, 14, 15.

Dividing Lines.

(17.) To divide a given line into 2, 4, 8, etc. equal parts.

(18) To divide a given line into any number of equal parts. Ruler & Square. Also, dividers.

(19) (Ruler & Square.) To divide given squares into 4, (9, 16, 25, &c.) equal squares.

(20) To divide a given oblong into 4, (9, 16, 25, etc.) equal rectangles all similar to the whole.

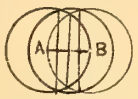
Applications. Scale = 1/12.

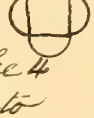
Divide a line, 2' long, into 3 ds

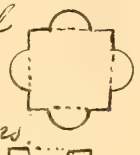
" " " 1½ yards " " 5ths

Can you divide a line into two such parts, that one part shall be three times (or five times or twice) the length of the other?

Can you divide a line into 4 equal parts, without using more than 3 circles?

Ans. 

Could you draw a semi-circle on each side of a 2ft. square? Ans. 

Can you divide the 4 sides of a 2'3" square into 4ths and, with a radius equal to one of these 4ths, describe a semi-circle upon the middle of each side? Ans. 

Same, with semi-circles inside of square 

Could you make an original design in one of the last figures?

Dividing Circles.

(21.) To divide an arc into 2, 4, 8, etc. equal parts.

(22.) To divide a circle into 2, 4, 8, 16, etc. equal parts.

(23) To divide a circle into 6, 3, 12, etc. equal parts.

Divide also circles and arcs with dividers.

Applications. (You may change dimensions given here.)

1 To inscribe a square within a 2' square.
2. To inscribe a rhombus " an oblong 2'x3'.
3. " " a circle " a 2'6" square.
4. " " " square " " circle, 1'2" radius.
5. " " two squares " " " 1'6" " .
6. " " a regular octagon " " " 1'4" " .
7. " " " " hexagon " " " 1'3" " .
8. " " an equilateral △ " " " 1' " .
9. " " two " " " " " 10" " .
10. " circumscribe a circle about a 2'3" square.
11. " " a square " a circle, 1' rad.
12 Can you draw, with instruments, any of the figures for the B 6th grade? (Fig. 242 & 243 excepted.)

Change size when necessary.

Note.

Do not draw every one of the last figures (in No. 12). When pupils understand well the problems already taught, they are able to draw those ex. without a special drill on each figure.

A 2p.

Summary. Protractor. — Angles. — Triangles. — Quadrilaterals. — Polygons. — Applications.

Angles. — Protractor.

(24) To bisect an angle. (Right, obtuse, acute.)

(25.) To divide a given angle into any number of equal parts. (Dividers.)

(26.) To make a protractor. (5° arcs.)

(27.) To draw an angle of ..... degrees.

(28.) To draw two adjacent angles of a given No. of degrees each.

(29.) To construct an angle equal to a given angle. (No protractor.)

(30) To find the no. of degrees of a given angle.

(31.) To bisect an angle, the sides of which do not meet.

Triangles.

(32.) To construct a right angled triangle

(33.) To construct an equilateral triangle

(34.) To construct an isosceles triangle:
(a) the base and sides being given.
(b) " base " altitude " " .

(35.) To construct a scalene triangle:
(a) the three sides being given.
(b) 2 sides and the included angle " "
(c) two angles " " " side " "

(36.) To find the altitude of any triangle.

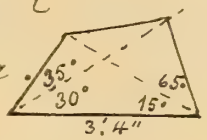
Quadrilaterals.

(37.) To construct a square: the diagonals being given.

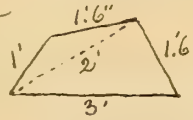
(38.) To construct an oblong: one side and one diagonal being given.

(39.) To construct a rhombus:
(a) the diagonals being given.
(b) one diagonal and one side being given.
(c) one angle " " " " " .

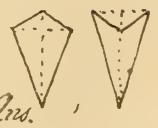
(40.) To construct a trapezium:
(a) the base and the adjacent angles being given ex.



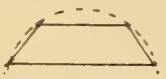
(b) the four sides and one diagonal being given. ex.



(41.) To construct two symmetrical trapeziums, each of a different form. Ans.



(42.) To construct a symmetrical trapezoid. Ans.



Polygons.

(43.) Upon a given base, to construct a regular hexagon.

(44.) Upon a given base, to construct a regular octagon.

(45.) To inscribe a regular octagon within a given square.

(46.) (a) To divide a circle into any number of equal parts.
(b) To inscribe within a circle any regular polygon.

Applications.

To draw with instruments, fig. of A 6TH, B 5TH and A 5TH course; (from p. 10 to 20.).

Leave out the figures in which the centers of curves are not readily found out, as in arcs with short altitudes, compound curves, etc. This rules out fig. 257 to 264 inclus. 267 to 270 incl., 274 to 276 " , 284, 295 to 299 incl., 303 to 305 " , 329, 379 to 381 " , 392, 393, 396, 399, 436, 437, 440 to 445 incl. 447 to 456 incl. 458 to 461 incl. 466, and 486.

See Note in B 2D p. 37.

B 1ST.

Summary. Circle. — Tangents. — Applications.

(47.) (a) To find the center of a circle.
(b) To find the radius of an arc
(c) To describe a circle (or arc) passing through three given points not in a straight line.
(d) To circumscribe a circle about a given triangle.

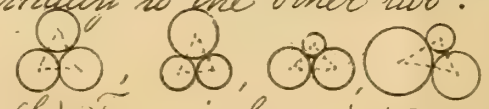
(48.) With a given radius, to describe a circle (or arc) passing through two given points.

Tangent Circles.

Note. When two circles (or arcs) are tangent, their centers and their point of contact are in a straight line.

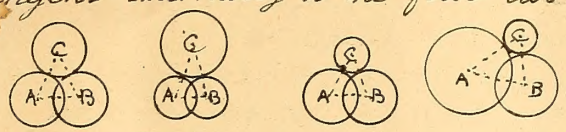
(49.) To describe a circle, with a given radius, tangent internally (or externally,) to a given circle, at a given point on the circumference of the latter circle.

(50.) (a) To describe three circles with given radii, each tangent externally to the other two.



(b) Two circles, not tangent, being given, to describe a third circle tangent externally to the first two.

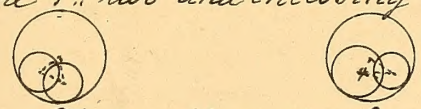
(c) Two secant circles, A & B being given, to describe another given circle, C, tangent externally to the first two.



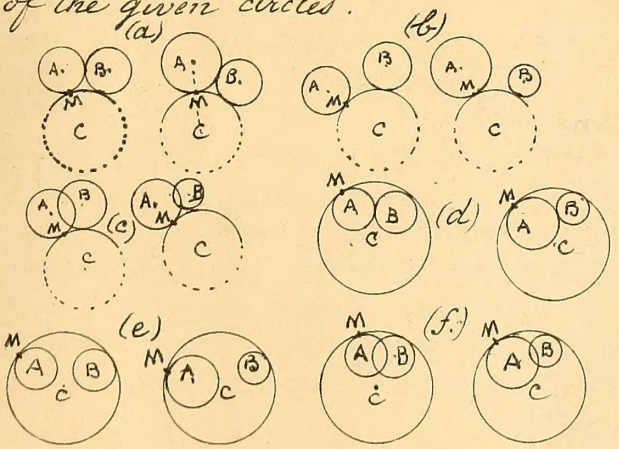
(d) To describe 3 given circles; the smallest two being tangent externally to each other and both tangent internally to the greatest.

(e) Two given circles not tangent being given, to describe a 3d circle tangent to the first two and enclosing them.

(f) Two secant circles being given, to describe another given circle tangent to the 1st two and enclosing them.



(51.) To describe a circle, C, tangent to two given circles, A and B, and to a point, M, on the circumference of one of the given circles.



Tangent Lines and Circles.

Note. Whenever a line and a circle (or arc) are tangent, the radius of the circle and the line are perpendicular to each other at the point of contact.

(52.) (a) To draw a line tangent to a given circle at a given point upon the circumference of the circle.

(b) To describe a circle, with a given radius, tangent to a given point on a line.

(53.) To describe a circle, tangent to two parallel lines.

(54.) With a given radius, to describe a circle tangent to both sides of a given angle.

(55.) With a given radius, to describe a circle tangent to two converging lines that do not meet.

Applications

Read "Note," at the end of B 2d page 37.

Can you draw with instruments such figures as Nos 242, 281, 284, 396, 436, 447, 448, 450, 456, 459, 461, 466, and all the figures of B 4th and A 4th except those containing ellipses and spirals, as Nos. 513, 556 to 561 inclusive, 571, 679, 680, 697 to 703 inclusive?

Can you describe a curve free-hand and then the same curve with instruments?

How would you use instruments to have both sides of these symmetrical curves alike? (Draw the curves free hand.)

A 1st.

(Summary. Tangents (Continued) — Ellipse, oval, spiral. — Similar figures. — Inventive drawing. — Plans and elevations.

Tangents.

(56.) (a) To draw a line tangent to a circle from a point without the circle.

(b) To draw a line tangent to two circles of unequal radii.

(57.) To inscribe a circle within a given triangle.

(58.) To inscribe a circle within a given segment.

(59.) To inscribe a circle within a given sector.

(60) To describe a cyma recta; — a cyma reversa.

(61) To describe a common scotia.

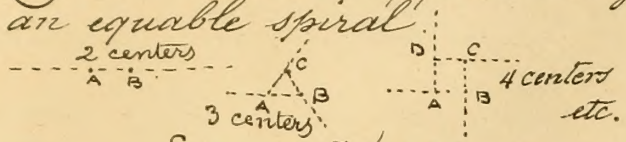
ELLIPSE, OVAL, SPIRAL.

(62) To describe an ellipse with a piece of paper; the axes being given.

Could you describe one with its foci?

(63) To describe an elliptical oval; — an egg oval.

(64) To describe approximately an equable spiral.



SIMILAR FIGURES.

(65) (a) To construct a triangle equal and similar to a given triangle.

(b) ..... similar to but greater than a given triangle

(c) ..... similar to but smaller than a given triangle.

Polygons can be divided into triangles.

(66) To construct oblongs, rhombs, etc. similar and equal to (or greater, smaller than) given oblongs, rhombuses, etc.

(67) To construct a square whose area shall be;

(a) double that of a given square.

(b) four times " " " — .

(c) 9; 16; 25 times " " " .

(d) $\frac{1}{2}$ time; 8 " " " .

(e) any fraction " " " .

(f) equal to that of two given squares.

(68) To describe a circle whose area shall be: 4, (9, 16,) times that of a given circle.

also: double; $\frac{1}{2}$; 8 times....

any fraction; equal to two given circles.

Application.

(a) Make any free hand figure (Use curves.)

(b) Enclose it in a rectangle.

(c) Divide rectangle into equal parts.

(d) Enlarge the whole pattern.

(e) Reduce it.

Any pattern may be copied, enlarged, or reduced in the same manner.

DESIGNING.

(a) Cut 8 or 10 paper units of this shape:  (a regular octagon.)

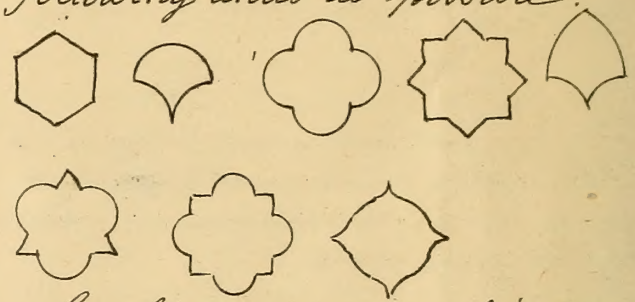
(b) Arrange these units upon your desk so as to make a pattern to cover an area.

(c) Draw your design with instruments.

(d) Ornament, or shade, such parts as will bring others in relief.

(e) If easier, work ornamental parts free hand.

(f) In the same manner try successively as many of the following units as possible.



Could you draw with instruments, fig. 513, 561, 679, 680, 699, 700, 702, 705, 706, 707, 708, 719, 721, 722, 755, 758, 761, 762, 767, 773, and 777. (Ornaments may be drawn free hand.)

Read note at the end of 132d p. 37.

Can you draw the plan of a floor; of the school house; working drawings of posts, doors, windows, tables?

Do not undertake any work too complicated.

Having been obliged to write and to arrange this manual in a limited time, I do not claim perfection for it. Any suggestions and criticisms for its improvement will be gratefully received by

Paul A. Garin.
815 – 35th St. Oakland. (Cal.)

Aug. 7th 1884.